

Design Collaboratory (DC)

The *Design Collaboratory* builds on the successful 46-year multi-disciplinary experience of this academic institution in developing an interdisciplinary design studio, which cultivates innovative models of practice. A team of professors, with over 40 years of collective cross disciplinary collaborative experience, and students from Architecture and Architectural (Structural) Engineering Departments with periodic involvement from the Construction Management Department (LEED workshop and student involvement on team) participate in a 20-week interdisciplinary design studio. This course has been taught since the 2007/08 academic year. This interdisciplinary team approach to building design has all disciplines involved from the inception of the building design project. Innovative uses of steel, integration of structure and design, and energy efficient cladding systems, are emphasized in this comprehensive design studio. The *DC's* collaborative practitioner partners are internationally recognized architecture and engineering firms, and the educational division of a major software company. Interdisciplinary student teams address complex structural/cladding systems, environmental issues, and use advanced digital technology tools, while simulating innovative collaborative practice strategies based on workflows demonstrated by leading design and engineering firms. This *Collaboratory* model expands the role of the practitioner in the academic design studio by having leading firms sponsor workshops, lectures and critiques across the disciplines to reformulate the methodology for integrating a practitioner's workflow strategies into a studio project. The students gain insight about, how industry integrates multiple strengthens of team communication by providing information that can be used continuously from design through fabrication and for developing and analyzing sustainable issues, and illustrating how practitioners lead collaborative teams.

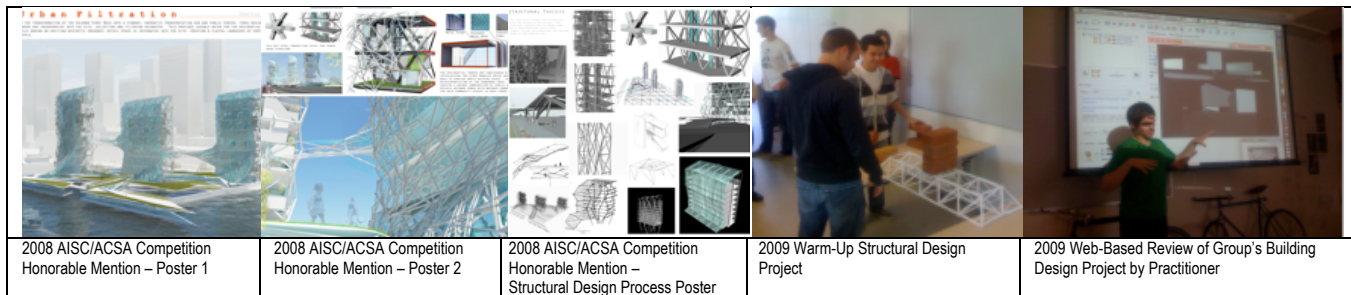
The five major *Collaboratory* activities are:

1. Practitioner Lectures/Workshops
2. Practitioner Reviews and Discussions in a Selected Practitioner's Office
3. Advanced Technology Training By Software Company and Practitioners
4. Digital and Physical Prototyping of Project Cladding System
5. Surveying and Documenting the Group Interactions for How Teams are Using Tools to Accomplish Tasks

Design Collaboratory (DC)

Introduction

The *Design Collaboratory* provides for an intensive two-quarter course sequence (20 weeks) designed to familiarize undergraduate students from primarily two departments (architecture and architectural engineering), and with periodic involvement from construction management, provides for a practiced based knowledge and application for how interdisciplinary teams can work together to design and construct buildings. All discipline students have a seat at the building design table and therefore students learn the fundamental principles for negotiation and building systems design integration. Students are provided a unique opportunity, not provided anywhere else in the curriculum, where they are all fully engaged in the studio design project that is enhanced by the support and collaboration with leading practitioners in the field.



Collaboratory Objectives:

For Learning —

- That students recognize that innovative structural and cladding systems, environmental issues and building siting and building constructability knowledge is not distinct from design knowledge;
- That students develop a “rules of thumb” working knowledge of core building design topics such as structural and cladding systems design, building siting and constructability, and LEED issues can be synthesized into their design studio project;
- That students learn to conceptualize buildings not as discrete objects that ONLY RELATE to their particular discipline, but rather as an assemblage of systems and elements that are connected to and interact with the larger world;
- That students are able to understand building design from the perspective of other disciplines involved for inFORMing and inspiring the development of building project;
- That students learn to develop leadership and partnering skills over the course of the studio that will be used as future professionals.

For Project —

- To challenge or transform the preconceptions about the boundaries between academia and practice;
- For firms to strengthen students’ preparedness for practice;
- To provide opportunities for practitioners to teach, mentor and recruit;
- For students to learn from and in a practice environment;
- To take advantage of one of the largest colleges of its kind that academically contains the five professions that create the built environment;
- To serve as an incubator for curricular initiatives for the entire College of Architecture and Environmental design.

Feedback Regarding DC

Practitioners

Architects

Our firm is interested in supporting this program by participating in structured critiques and active collaborative studio activities (workshops and design charrettes). We believe that this (Design Collaboratory) is the future of our profession; establishing collaborations between academic department and outside practice to bring the best teaching scenario forward to the students.

Engineers (Structural and Environmental)

Our involvement (with the Design Collaboratory)...has included workshops on campus and at our offices. These workshops have combined presentation on structural systems and interdisciplinary workflow and student project reviews. (From these activities), we have seen the benefits of the teams coalescing and finding their own methods for full team integration.

We believe that this (Design Collaboratory) is a rare and unique opportunity to provide an extraordinary studio exploring practice.

Software Company

(The Design Collaboratory's) approach to focus on particular components of the building (curtain wall and structural systems) allows students to engage in a very detailed dialogue across disciplines with regard to materiality, structure, cost and procurement. The scale (of the project) also allows students to explore BIM functionality at various levels so that they can understand more about the logic of using this tool. (The Design Collaboratory is an important) teaching pedagogy for these evolving technologies.

Architectural (Structural) Engineering Students

As an ARCE, the interaction of professionals was an unexpected and appreciated addition to this project. I enjoyed the experience because it was the first time I had a member of industry actively change/interact/critique my school work. This was possibly because of the models the architects created – visually critiquing is far easier than critiquing structural calculations (but this only occurred at the much later stages of the project).

I have never learned more about what it takes to make a building stand up until this studio. The second thing I learned is about how much a design can change when collaborating with other disciplines. I learned that there are many facets of design, and design (at least the way our major sees it), is just a part of the many things that have to happen in order to make a building work.

Prior to this course, I knew the importance of structure in the building, but I never knew how much things had to change because of that structure.

The participation of the (outside practitioners) in (assisting with our design projects) was very helpful and educational. I preferred the in person reviews best, but the web conferences also proved extremely useful. Many changes to our skin and its environmental performance came as a result of their input.

Construction Management Student

Architectural engineering at Cal Poly seemed to be the perfect combination of the delicacy of architecture and the rough lifestyle of contractors.

Architecture Students

Architects can get a bit stuffy and repetitive and any beneficial input from others outside of architecture is greatly appreciated.

Bringing in professionals was by far the most important experience that took place in this studio. Not only were they forward thinking in terms of design ideas, but they knew what it took to get things built. This information helped us to realize our designs in a more realistic light.

The advantages of the interdisciplinary studio are: (1) You learn how important it is to be on the same page as the engineers and that requires a large amount of communication and discussion. (2) You learn that there are real constraints on the project and that not everything is possible. (3) You learn that engineering students are very different than architecture students.

(The participating professionals) got our group thinking as a team with the RISA-3D (structural engineering analysis software) and Rhino (3D digital modeling software) form-finding workshop and then having the (follow up) reviews from engineers and architects helped us to have confidence in the direction we were moving.

I learned (1) that when you work in a group you rarely get stuck on what the next move should be. The collective minds of a group contribute to this. I also learned (2) that having the building's structure figured out (early on in the design process) makes the project much stronger and for me that was important because in the past I thought of structure last. Having the (structural engineering students) in the group was a big factor and talking to the instructors helped us to figure it out. Lastly, (3) I learned that reviews can be very constructive (when practitioners are involved)... instead of feeling like you have to defend your project...

...(Collaborating) forced me to see how structural engineers see things and to take that into consideration when describing our design ideas. I had to be more concrete which is definitely not a bad thing.

I came into this studio with the preconceived idea that I was better off working alone. (However), working with the ARCE students gave me an insight to structure and structural engineers I have not been exposed to. Also, being able to see a project through in its entirety will benefit me greatly when working on my own thesis project next year. I now know what is possible and what I am capable of (and I know the benefits of working in interdisciplinary teams).

The project expanded my abilities to work in groups and communicate effectively. As cumbersome as the many presentations were, they were beneficial to learning to communicate about a project where the reviewers do not already have an intimate knowledge of it. I learned that conveying details as they relate to the project as a whole is a more complex task than I had anticipated.

The winter and spring quarters spent in the interdisciplinary design studio were, without a doubt, my two most valuable quarters so far at (this University). Not only were they mightily challenging for various reasons, (but) they were educational and informative as well.

DC Structure:

This design studio meets two days a week on Tuesday and Thursday from 1-6 and as needed on Saturday (for practitioner based advanced technology workshops).

Interdisciplinary groups range in size. Currently there are 6 groups with 3 architecture students and 2 structural engineering students. In 2008 there was a group that had 4 architecture students, 2 structural engineering students and one construction management student providing input on project's constructability and LEED analysis. The design studio is structured to have groups work to rotate leadership, have formal group meetings twice a week to set goals and to accomplish weekly project deliverable requirements.

A total of 4 instructors co-teach this Design Collaboratory: Three architecture professors and a structural engineering professor. There is also periodic involvement from Construction Management (CM) faculty to provide lectures on LEED and building constructability overviews in addition to having CM students consult with teams. All faculty participate in providing overview lectures on a range of topics plus participate in the weekly interactions/critiques with student teams.

DC Schedule Details

This is a two-quarter course, which will last for a total of 20 weeks and are divided in 5-four week segments:

Weeks 1-4 Theme: Foundation – Team/Skill/Tools Building Activities

- Building Precedent Analysis – Examination of structural and cladding systems, environmental issues, siting issues of project supplied by practitioner firms.
- Practitioner/Faculty Lectures and Practitioner Advanced Technology Workshops - plus Q&A of practitioners on design discussions of case study projects analyzed. Plus Software Company training workshops on BIM and EcoTec Software (this training is new this year).
- Practitioner lead form finding seminars using advanced technology (e.g., 3D RISA/Rhino, etc).
- Several Design Charrettes for Assigned Studio Project (based on precedent analysis).

Weeks 5-8 Theme: Building Design Development – Technology Application

- Design Studio Project Development with input from practitioners.
- Application of Precedent Study Knowledge + Use of Advanced Technology Training on the design of project.
- Mid – Review Critique at the Identified Practitioner's Office.

Weeks 9 – 12 Theme: Building Project Refinements [Academic Week Long Break in the Middle]

- Design Project Refinements.
- Start of the Large Scale Cladding System Digital/Physical Mockup Design Process.

Weeks 13 – 16 Theme: Final Building Project Review – Digital/Physical Mockup of Cladding System

- Final Review at the Identified Practitioner's Office.
- Send off entries to the International ACSA/ASC Steel Design Competition.
- Continuation of the Large Scale Cladding System Mockup Design Process.
- Team Starts Documentation of Total Design Work Process.

Weeks 17 – 20 Theme: Documentation/Reflection + Fabrication

- Large-Scale Digital and Physical Cladding Mockup Due.
- Team Completes Documentation of Design Work and Reflects on What Was Learned.

DC ROLES OF PRACTITIONERS AND FACULTY

ENGINEERS

Practitioner A, PE: Internationally acclaimed engineering firm 1 - Guest critic for the *Collaboratory* for the last 2 years. Role — Lectures on the design process for structural systems integration. This practitioner believes that, "The advancement of structural engineering principles combined with the artistic collaboration between architecture and engineering is what I find most rewarding about my career. The combination is essential to the success of any building, and to the well-rounded education of both architects and engineers,"

Practitioner B, PE, Phd: Internationally acclaimed engineering firm 1 - Role — Lectures/Workshops on form finding software and work flow analysis. His educational background focused largely on the form-finding of load bearing structures, in particular the analysis of geometrically non-linear structures of complex geometry that require iterative computational methods.

Practitioner C, CE: Internationally acclaimed engineering firm 1 - Role — Lectures on the integration and sustainable design of structural systems.

Practitioner D, BEng CEng MIEE MCIBSE: Internationally acclaimed engineering firm 2 - Lecturer and critic for the *Collaboratory* for the last 1 year. Role — Lectures on the integration of environment systems. He became a Principal in May 2005. He is a Chartered Engineer, a Member of the Institution of Electrical Engineers and an Affiliate of the Chartered Institute of Building Services Engineers. His design philosophy is that successful environmental design is achieved through influencing the architectural language, form, function and fabric of a building to maximize the potential for passive ventilation, temperature control and day lighting solutions.

ARCHITECTS

Practitioner E, RA: Internationally acclaimed architecture firms - Guest critics for the *Collaboratory* for the last 1 year. Role — The building design approaches and process and project siting. As a Principal, she is a liaison with clients during all phases, and as Project Manager she coordinates the effort of the entire project design team from design through construction. She also maintains a supervisory role to all of the practices design teams worldwide. He is a principle and directly involved with the workflow design issues in this office and the integration of BIM for all projects.

Practitioner F, AIA: Worldwide Education Programs, Software Company - Guest critic for the *Collaboratory* for the last 2 years. Role — Workshops on BIM Software and building sustainability analysis (for cladding systems energy analysis) Software. She has more than 11 years of experience teaching hands-on, technology-driven design studios in architecture, interior design and landscape architecture at both the graduate and undergraduate level and has practiced architecture for 15 years.

FACULTY

Faculty Member A, AIA, University Professor - Role — Co Teacher for the *Collaboratory* for the last 2 years. This faculty member has cladding systems, building systems expertise and 16 years of multi-disciplinary collaborative team experience with one of these practices in New York, Sydney and Los Angeles. He is a Professor of Architecture and his teaching responsibilities include third and fourth year design and building technology courses, as well as a number of electives exploring issues of integrated practice, prefabrication and digital production. His work and research focuses on connecting conceptual design to digital fabrication methods using digital tools to supplement the design process. He has lectured in the United States and Australia on the topics of interdisciplinary teamwork, prefabrication, museums, digital culture and media, and sustainability.

Faculty Member B, AIA, NCARB: University Professor - Role — Co Teacher for the *Collaboratory* for the last 2 years. This faculty member concentrates on design studio teaching methods and has 11 years of multi-disciplinary collaborative team expertise. He is a Professor of Architecture and has over 15 years of practice experience working for architectural firms in New York City and Washington DC and over 20 years of teaching experience. Teaching responsibilities include third and fourth year design and building technology courses, working with a range of independent study students and directing his digital media facility founded in 1997, called the Collaborative Integrative-Interdisciplinary Digital-Design Studio (CIDS).

Faculty Member C, SE, CE: University Associate Professor - Role — Co Teacher for the *Collaboratory* for the last 2 years. This faculty member has cladding, building systems, and multi-disciplinary team experience working with practices in San Francisco, Los Angeles, and London. His teaching responsibilities range from 2nd year technology classes through graduate structural systems and seismic engineering courses and he has been teaching a collaborative design studio for the past five years. He is an Associate Professor of Architectural Engineering and is licensed as a Civil Engineer and Structural Engineer in the State of California. He has 13 years of experience working with a renowned international engineering firm, where he worked in both the San Francisco and London offices where a collaborative work environment were the underpinnings of the company culture.

Faculty Member D, AIA: University Assistant Professor - Role — Co Teacher for the *Collaboratory* for the last 2 years. This faculty member has digital fabrication expertise and 10 years of multi-disciplinary collaborative team. As Assistant Professor of Architecture, his teaching responsibilities include teaching third and fourth year design integrated with practice courses focusing on structure, material assemblies and cladding, as well as electives on material form finding and digital fabrication. He has taught several design-build studios and has published on a collaborative atelier model of studio education through full-scale installations enabled by digital fabrication. His doctoral research focuses on the culture of practice enabled through digital fabrication including the collaborative enterprise of digitally based design practices and their reflection upon design education.

Faculty Member E, AIA, Licensed Contractor University Full-Time Lecturer – Will consult with the *Collaboratory* (new this year) and has polymer materials, use of Constructor BIM software for scheduling and cost estimating and 20 years of multi-disciplinary collaborative team expertise, the faculty advisor to the award winning construction management student BIM team and a range of student interdisciplinary community design build projects.

Design Collaboratory

Interdisciplinary Design Teams

ARCHITECTURAL ENGINEERING – Senior Projects may include analysis, design, experimental testing, research, or construction	ARCHITECTURE - the design of individual buildings in either a rural, suburban or metropolitan context. Particular emphasis is placed on multi-function buildings and the furthering of the students' ability and experience in the analysis, design and comprehensive integration of activity, circulation, esthetic, structural, and environmental control systems. The projects selected for this course are of sufficient complexity and realism to make students aware of and to prepare them to deal with the opportunities and constraints of real programs, users, and clients as they are dealt with in architectural practice.	[Periodic Involvement] CONSTRUCTION MANAGEMENT – Senior Projects may include practical application of construction management theory and practice solving problems related to the built environment.
Team Deliverables: To design a building project that has integrated programmatic, structural, sustainable (siting and cladding), life safety and building service systems.		

Student Evaluation Rubric

NAAB Criteria (A) = Ability	Skills	Comment	Evidence	Weak (—)	Competent (✓)	Strong (+)
(A) Speaking and Writing Skills	Writing in architecture	May be internal and external to project	Extended captions, concept statements, written narratives, reflective essays, and technical reports	Never writes to professional audience Descriptive, feelings-oriented (420?) Significant errors Little or no writing in project	Sometimes writes to professional audience Writes about project – its specific qualities such as structure, orientation etc. Minor errors Writing aids drawing in form of titles, labels, notations, and captions	Consistently writes to professional audience Clear theme; hypothesis, development, and synthesis Error-free Titles, labels, notations, extended captions, concept statements, and reflective essays work together with drawings to make convincing argument
(A) Graphic Skills (A) Technical Documentation	Graphic communication	Ability to muster various media to form coherent presentation of project	Analytical diagrams; analog/digital plans, sections, elevations, and axonometric drawings	Little understanding of conventions Presentation incomplete Narrative confused Unbalanced media: analog or digital, hardline or freehand, drawings or models	Some understanding of conventions Complete presentation Coherent narrative Somewhat balanced media: analog and digital, hardline and freehand, drawings and models Whole of presentation is greater than sum of parts (strong?)	Conventions mastered Complete presentation Coherent and convincing narrative Well balanced media: analog and digital, hardline and freehand, drawings and models
(A) Critical Thinking Skills (U) Formal Ordering Systems (A) Fundamental Design Skills	Critical thinking and graphic analysis	Ability to assess situation, develop alternatives, and provide rationale for project	Analytical diagrams, alternative solutions, process documents	No assessment of situation No alternative generation No rationale for project	Some assessment Alternative generation but no rationale for project	Thorough assessment Alternative generation and rationale The Why: student can make argument about project
(A) Use of Precedents	Architectural research and use of precedents	Ability to gather, assess, record, and apply relevant information (NAAB). Precedent studies as critical component.	Comparative diagrams, drawings and models that explore connections to project	Cut-and-paste precedent studies; little or no analysis; little or no application to project	Precedent studies re-drawn to consistent scale; graphic and textual analysis; conclusions drawn but not well applied	Precedent studies re-drawn to consistent scale; graphic and textual analysis; conclusions drawn and well applied to project
(A) Collaborative Skills	Collaboration	Within and between disciplines; evidence that students learn from each other	Teamwork in research and design showing individual and collective effort, description of process/product, self-evaluation of team members	Teamwork acknowledged but not substantiated in project	Teamwork acknowledged and evident in research Unclear relationship between individual and collective effort	Teamwork acknowledged and evident in research and design Clear relationship between individual and collective effort
(A) Program Preparation	Programming	Ability to connect program to project	Goals, definitions, mission/vision statement, diagrams, models, narratives, and precepts	Minimal program with no clear application to project	Program developed and applied to project	Well-developed analytical program applied with clarity and imagination to project.
(A) Site Conditions (A) Environmental Systems (A) Building Envelope Systems	Responsiveness to site conditions	Principles that govern design of buildings and groups of buildings, as well as site itself	Diagrams that document and investigate; site plans, sections, and models	Little or no site description No analysis Little or no useful conclusions pertaining to design of building	Site description and graphic analysis Conclusions drawn and applied to design of building or group of buildings	Substantial site description and analysis Conclusions drawn and applied to design of group of buildings and site itself
(A) Structural Systems (U) Life Safety (U) Building Envelope Systems (U) Building Service Systems (U) Building Systems Integration (U) Building Materials and Assemblies (A) Comprehensive Design	Systems integration and sustainable design	Design concept absorbs issues of structure, ECS, egress, and skin, showing student understands principles of sustainability	Diagrams, structural models, articulate wall/building sections and section models	Design concept resists systems integration, no consideration of sustainability issues	Design concept begins to integrate systems and sustainability	Design concept and development integrates systems and sustainability

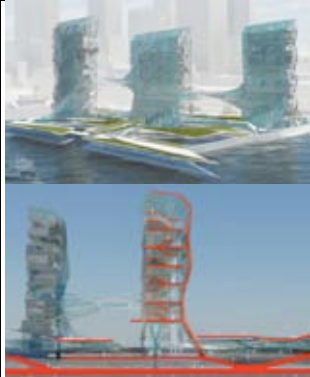
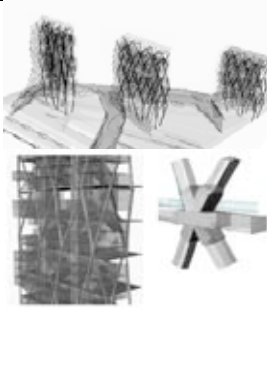


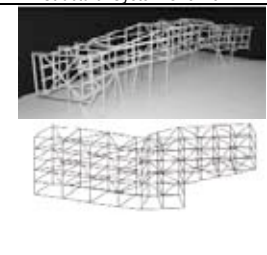

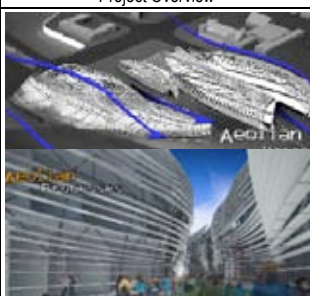
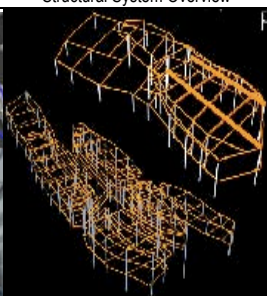
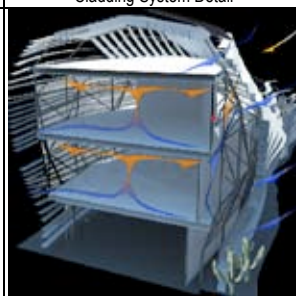

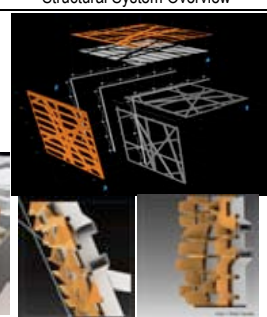

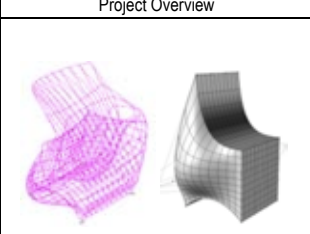


STUDENT WORK

[A Collage of Selected Samples of Work]

Selected Quotes from Students Regarding Interdisciplinary Team Work:

- *Working with architects forced me out of my comfort zone. They pushed me into the realm of a nontraditional structural steel design and the project only benefited. This collaborative class is one of the best educational experiences I have had while in school.*
[Engineering Student]
- *Working with multiple disciplines for this design project was a great experience. It allowed multiple perspectives in the design as well as some compromises that had to be made as a group. It was a great team environment that gave us a realistic approach to a steel design project. Having to do the presentation at a firm with different professionals makes you realize the importance of the project.*
[Architecture Student]
- *This experience gave me the opportunity to explore fields and programs that I would not normally be exposed to. Through interactions with architects and engineers, I had a glimpse of issues and solutions that a real consultant (and contractor) would face.*
[Construction Management Student]

SAMPLING OF DESIGN COLLABORATORY STUDENT WORK

Housing Tower #1 in Seattle, WA			
	Project Overview	Structural System Overview	Cladding System Detail
Housing Tower #2 in Seattle, WA			
	Project Overview	Structural System Overview	Cladding System Detail
Performing Arts Center and School #1, Phoenix, AZ			
	Project Overview	Structural System Overview	Cladding System Detail
Performing Arts Center and School #2, Phoenix, AZ			
	Project Overview	Cladding System Structure	Large Scale Cladding Detail Model
Practitioner Interactions (Workshops, Lectures) Plus Design Charrettes, Field Trips, Precedent Studies			
	Workshops (Form-Finding, etc) and Design Charrettes	Selected Precedent Studies	Field Trips

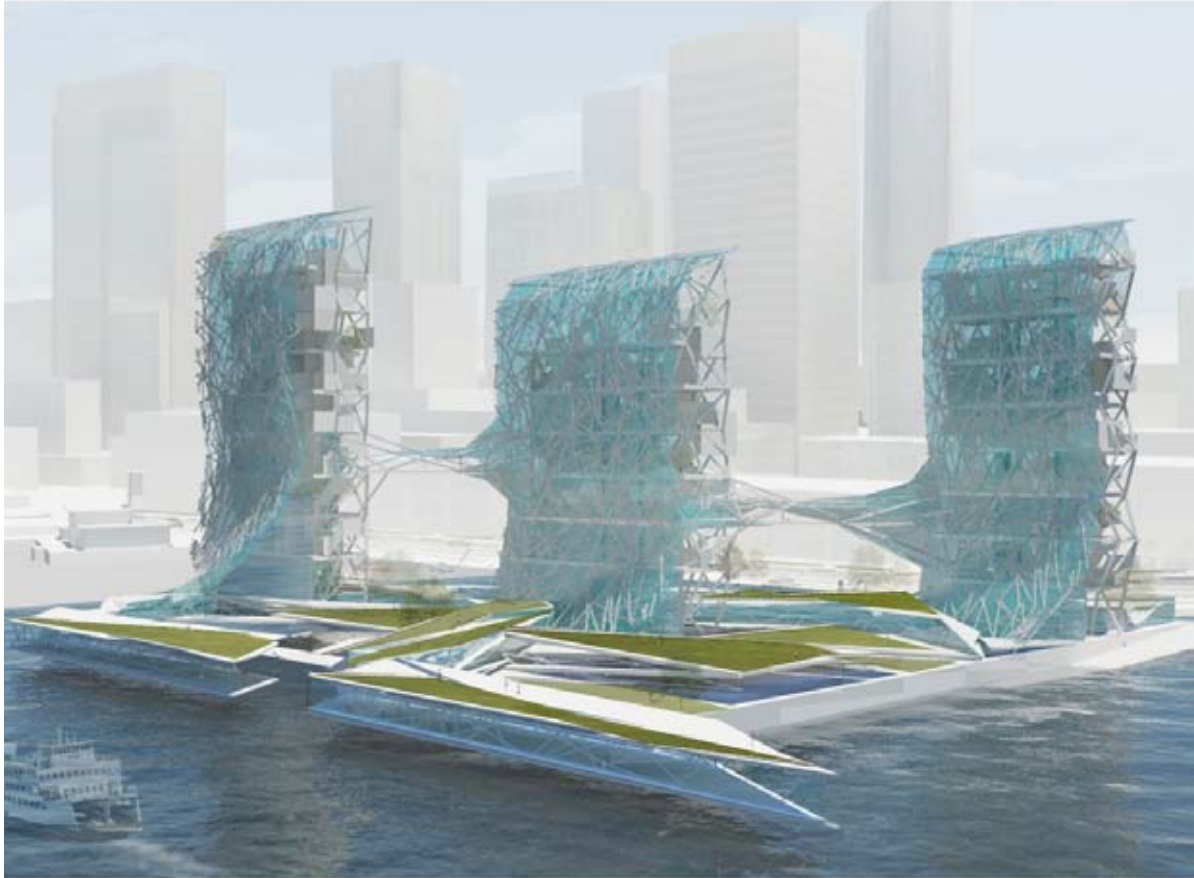
	
Project Narrative:	URBAN FILTRATION
<p><i>[Note: This project won an honorable mention award from the ASCA/AISC "Steel Competition" Project in 2008.]</i></p>	<p>Site: The site is located in Seattle, Washington on the Colman Dock waterfront. Here on Pier 52, commuters and visitors travel via Washington state ferries from Bainbridge Island and Bremerton to arrive in downtown Seattle.</p> <p>Concept: Seattle's weather forecast frequently includes rain, and the Coleman Ferry Dock's location at a low point in the city's topography means the site receives run-off from the entire downtown area and surrounding parts of the city. Water also traces the paths of human circulation through the site, which flows from downtown Seattle to the Puget Sound. Both rainwater and run-off are collected on site and filtered through the screens of each residential tower to provide clean water to the residents. The playful articulation of the ground plane provides retail space and protected access to the ferry terminals as well as a park-like setting for residents and visitors alike. This multiuse project aims to create a sense of community through a balance of housing, greenery, and retail space while speaking of Seattle's intimate connection between people and water.</p> <p>Program Configuration: In order to maintain and encourage the current flow of pedestrian traffic, the retail arms trace the movement of water onto the site through the placement of two major entries at the intersection of Columbia and Marion streets with Alaskan Way that borders the eastern edge of the site. Each of the three towers is sited between these major paths of circulation and raised above the retail on canted structural columns to provide privacy. Parking is located underground and the ferry building now juts out into the water on its own private jetty to accommodate commuters without disturbing the residences. Along the main retail arm that runs through the site to the water's edge to provide a covered thruway to the ferry dock, there is a sheltered amphitheater space for community events in the park.</p> <p>Circulation/Public and Private Areas: Since the program includes a combination of residential and retail spaces on site, differentiation between public and private areas was crucial to allow the inhabitants privacy from the busy ferry terminal and retail located below the residential units. In a reinterpretation of the suburban ideal, two-story-interlocking modules are offset from the edge of slab to provide private outdoor spaces. Since not all households are the same, three different sized modules that range from a one-bedroom unit for individuals or couples to a three-bedroom unit for families are configured within the residential towers. These three modules are arranged to create various sized green spaces that occasionally punctuate the entire width of the tower and are organized both as private spaces for individual modules and larger community spaces that are connected between towers via pedestrian bridges.</p> <p>Skin / Structure: An organically inspired three-dimensional steel truss system lifts the ground plane in slices to expose a network of retail leading to the three residential towers and ferry terminal. The playful landscape of articulated green roofs serves to provide protection from the rain, light to the lower parking level, and an extensive park as a new community social space. Using the varying planes of the roof and realistic beam spans, a system of triangulation was developed to determine the truss form. This system appears organic because of the constantly changing variables of span and roof location but is in fact rationally derived. A similar system, though scaled down, is used in the residential screens. The screen structure is designed not only to support the glass and ceramic filtering system, but also some of the lateral forces experienced by the towers. A steel mega structure in a canted diamond pattern spans four floors and establishes points that were used to derive the screen structure patterns. Open braced frame cores faced with glass provide lateral stability and elevator access to the modules. Peeling up and out from the ground is a water filtration screen that cleans storm and rainwater flowing into the site and delivers fresh water to the apartments contained in the residential towers. The runoff is first screened of debris and collected</p>

	<p>at the base of the towers where it is stored in large, exposed tanks before being pumped up through the elevator cores to the top of the towers. As the dirty water runs through the ceramic panels that are cut to mimic the steel screen structure that supports it, microscopic particles are filtered out by the ceramic's pores and by the time the water reaches the first floor of the towers it is clean. Here the water flows through a break in the screen to trickle down as a water wall into a collection area at the base of the residential towers.</p> <p>The clean water is then stored in tanks before being pumped up along the cores once more and distributed to individual apartments via pipes imbedded in the slabs.</p> <p>A system of five materials is employed to filter the water. The first layer, located on the outermost portion of the screen, is the water-collecting nanomaterial coating. Inspired by a desert beetle, a pattern of alternating raised hydrophilic (water attracting) sections, which cause tiny water droplets to attach, and hydrophobic (water repelling) surfaces, which catch droplets that spill over from the hydrophilic section is used to attract condensation in the air onto the screens to be filtered. Second, a ceramic layer uses the material's natural microscopic pores to prevent the passage of bacteria or viruses while water molecules emerge from the filter free of contaminants. The third layer is made up of Powerglass panels, glass that is imbedded with translucent photovoltaic cells without visible lines or patterns to generate electricity for the site. The glass also protects the structural steel layer, which is constructed as a truss system similar to the retail structure, from the corrosive effects of water. The last material is a bioluminescent coating applied to the structural steel facing the residential units to provide a diffuse glow during overcast weather and at night. The various screen layers are held together with a simple bolt system that runs through the ceramic, glass and steel at each major intersection of the panels.</p>
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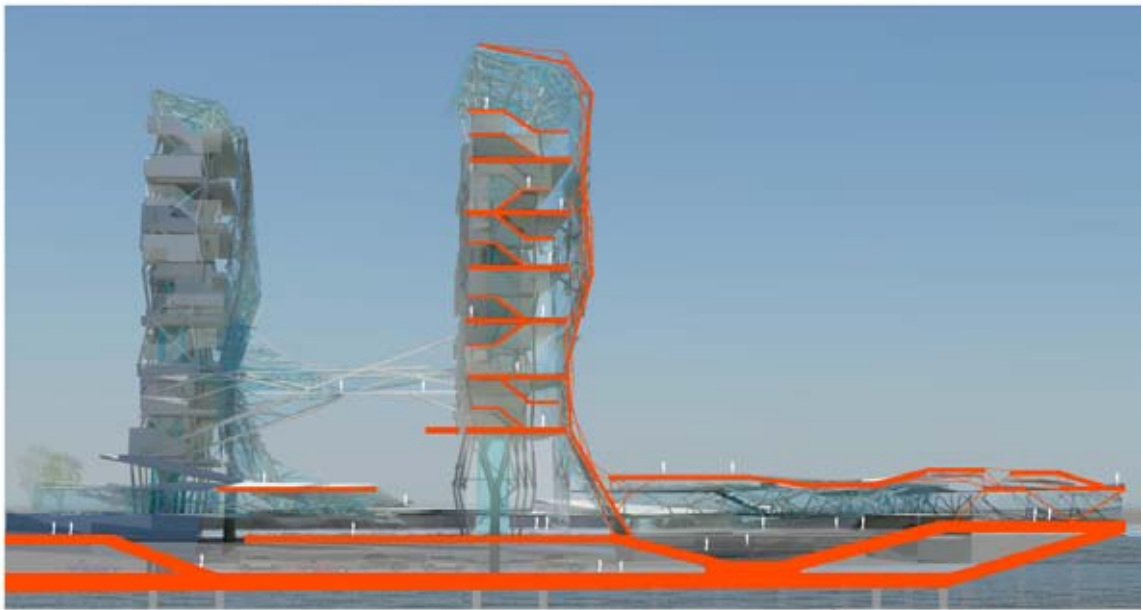
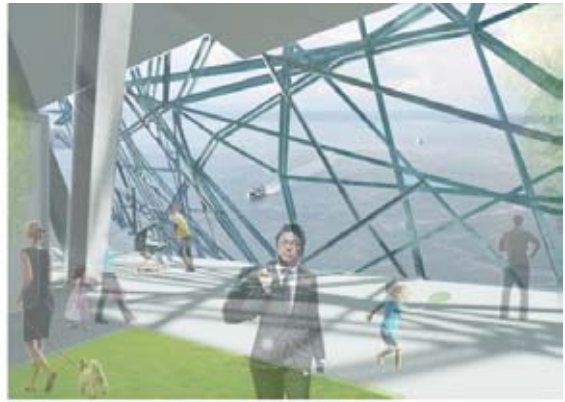
Urban Filtration

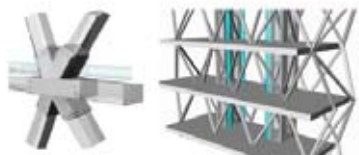
SEATTLE, WA

IN THE TRANSFORMATION OF THE COLEMAN FERRY DOCK INTO A VIBRANT, ENERGETIC TRANSPORTATION HUB AND PUBLIC CENTER, THREE RESIDENTIAL TOWERS ARE INCORPORATED INTO THE SITE, COLLECTING AND FILTERING RAINWATER. THIS PROVIDES USEABLE WATER FOR THE RESIDENTIAL UNITS, WHILE ADDING AN EXCITING AESTHETIC PRESENCE. RETAIL SPACE IS INTEGRATED INTO THE SITE, CREATING A PLAYFUL LANDSCAPE OF VARYING LEVELS.

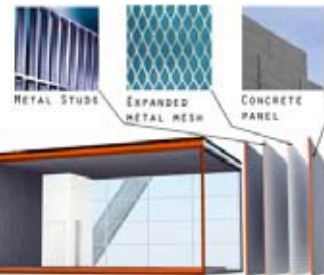


RAINWATER AND RUN-OFF ARE COLLECTED ON SITE AND FILTERED IN THE SCREENS OF EACH RESIDENTIAL TOWER TO PROVIDE CLEAN WATER TO THE RESIDENTS. WATER TRACES THE PATHS OF PUBLIC CIRCULATION THROUGH THE SITE, FLOWING FROM DOWNTOWN SEATTLE TO THE COLEMAN FERRY DOCK ON THE PUEBLO SOUND.





SIX WAY STEEL CONNECTION JOINT FOR TOWER
MEGA STRUCTURE



THE RESIDENTIAL TOWERS ARE CONFIGURED WITH INTERLOCKING TWO STORY MODULES WHICH ARE SET BACK TO PROVIDE AMPLE OUTSIDE SPACE. THIS REINTERPRETATION OF THE SUBURBAN IDEAL CREATES A UNIQUE COMBINATION OF PUBLIC AND PRIVATE OUTDOOR ZONES WITH BRIDGES CONNECTING THE MAIN COMMUNITY SPACES IN EACH TOWER.





Water Collecting Nano Material



Ceramic Water Filtering System



Steel Truss System

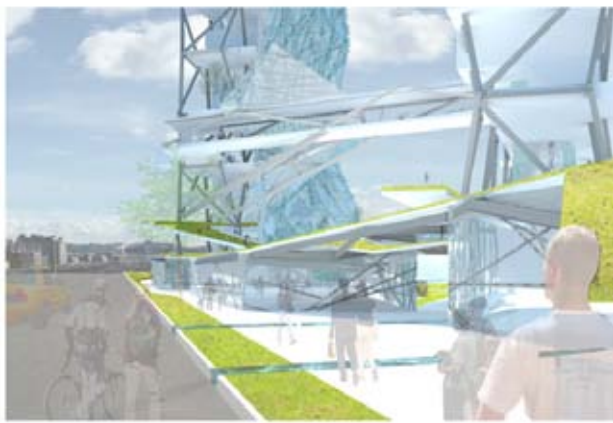


Steel Truss System

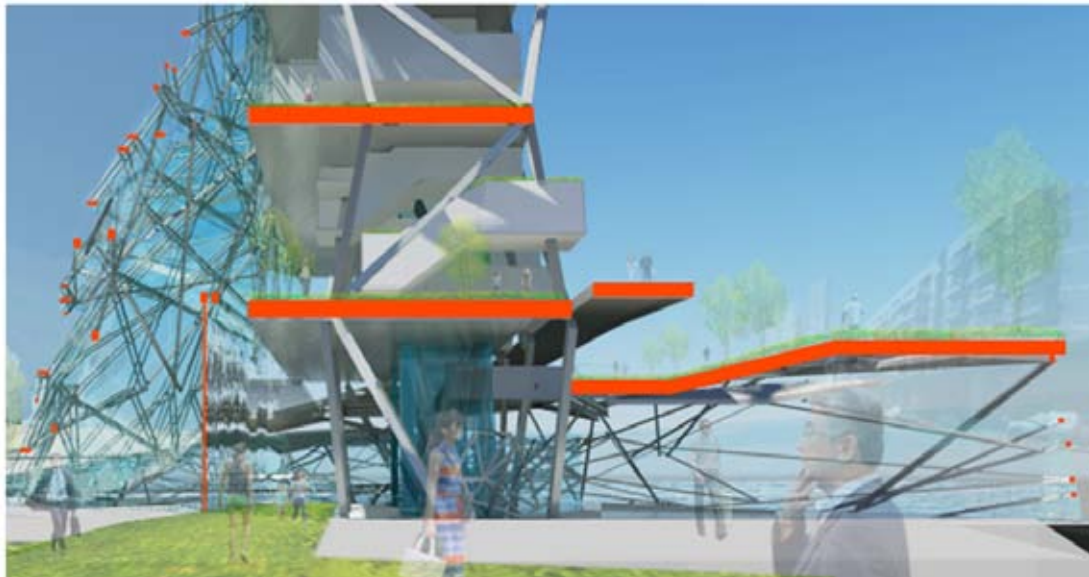


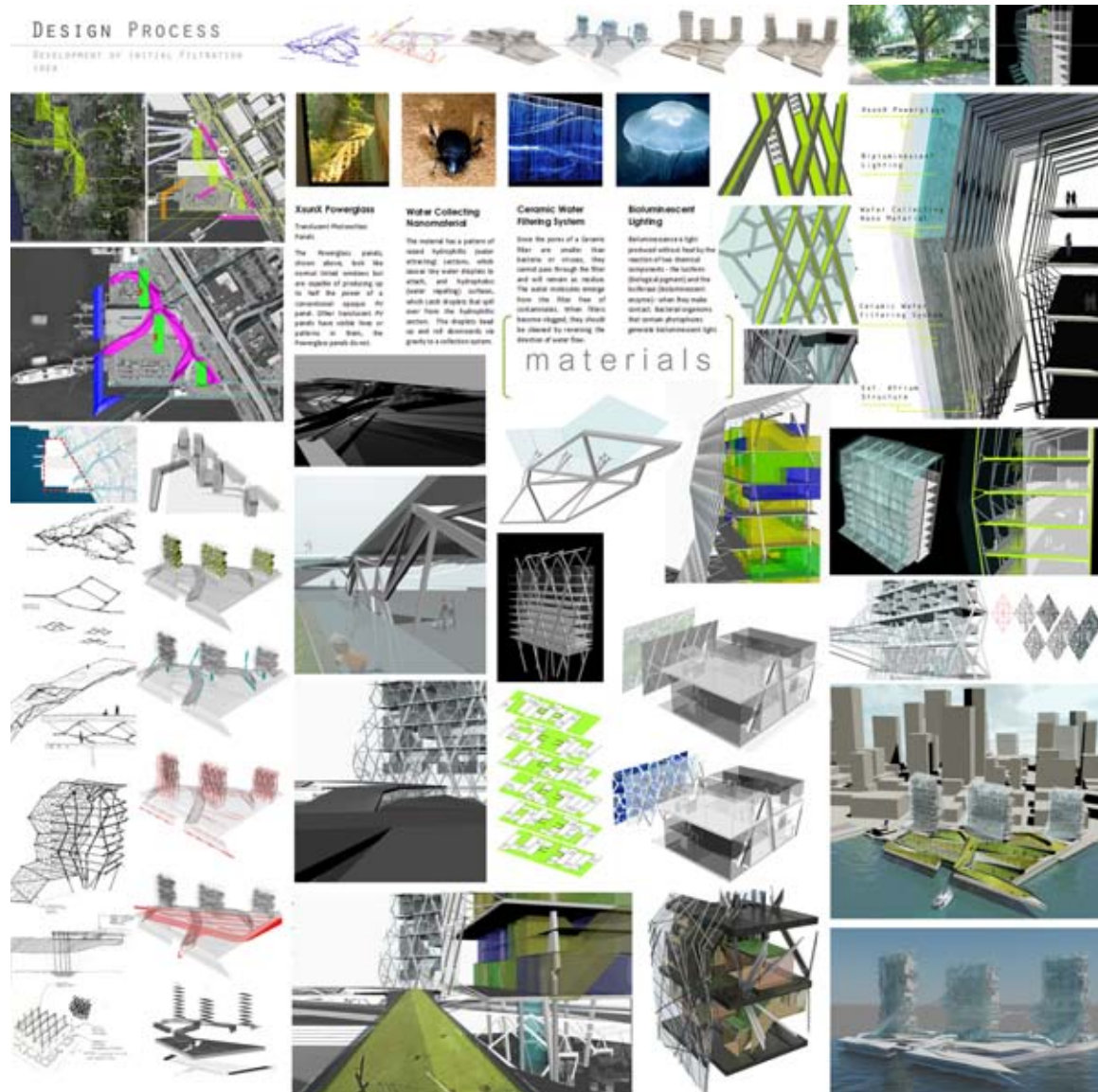
Steel Truss System

EXTERIOR SKIN OF THE RESIDENTIAL TOWERS IS EQUIPPED WITH A WATER COLLECTING NANO MATERIAL AND CERAMIC FILTRATION SYSTEM TO FILTER RAINWATER AND SITE RUN-OFF.



AN ORGANICALLY INSPIRED THREE DIMENSIONAL STEEL TRUSS SYSTEM LIFTS THE GROUND PLANE IN SLICES TO EXPOSE A NETWORK OF RETAIL LEADING TO THE THREE RESIDENTIAL TOWERS AND FERRY TERMINAL.






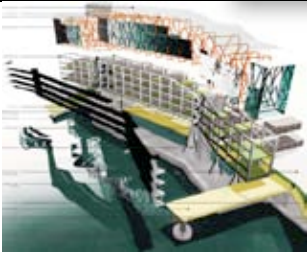
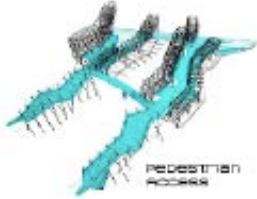

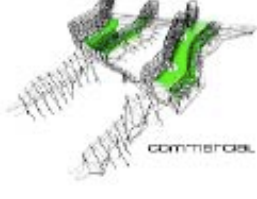


Design Process

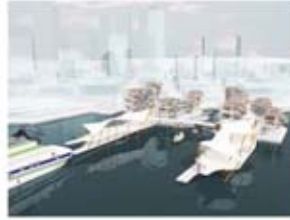
THE STRUCTURAL SCHEME GROW ORGANICALLY WITH THE GROWTH OF THE BUILDING. THE STRUCTURE STARTED WITH A LINEAR FORM WHICH THEN DEVELOPED INTO A MORE DYNAMIC SYSTEM THAT REFLECTED THE MATERIAL FORMS OF THE ARCHITECTURE.



	
	Selected Reflective Comments From Team
	<p>Collaboration:</p> <p>I felt that as a team, my group came up with a much richer design, strengthened by the ARCE team's input to create something a new innovation in my school career: a group project that has transformed my own thinking and helped me to continue to develop my design skills and thinking. Encouraging group projects as at least a way to begin the quarters is a good way to create interaction and a team mentality—a skill that is important in the architecture field.</p> <p>Design Process:</p> <p>The initial design charrette was a huge leap for our team, and the success of the first charrette propelled our team forward into developing sketches of our screen filtration idea, organic structural system, research in developing a materials system for the screens and the set up of the vertical suburbia. In winter quarter, Rachel and I worked very closely, dividing the work between us, and meeting every few days to update the combined digital file, go over ideas, and updating each other on new design developments.</p> <p>I worked a lot in my sketchbook drawing ideas for the design, and then once my colleagues and I had discussed them, we would implement it digitally. Initially we had the work divided up between the towers and the retail; I worked in Rhino drawing up the landscape, parking level, and retail structure (which was extensively revised over time) while my colleagues worked on the structure for the residential towers and the screens. Later on, I also became involved in digitally drawing the screens, creating details, developing the patterns, and applying it to the master model. I also worked extensively on the modular apartments, coming up with floor plans, modeling them in Rhino, and modifying them as necessary. As far as digital modeling, my colleague focused primarily on modifying the mega structure for the towers, placing the completed apartment modules, and modifying the finalized screens I had drawn to create a more three dimensional structure.</p> <p>I had not used 3D Studio Max before, but in the end my colleague and I rendered and Photoshopped an equal number of images on the final competition boards. The images that a colleague in the group worked on tended to be larger sectional and perspective images, while my focus on the details of the project naturally led to my rendering more of the detail images that did not need to be as prominent. As it was my colleague and I both created the digital file, drew sketches, built analog models, and rendered the final images. The only thing I took upon myself was to send out regular group emails to everyone summarizing team meetings and what was expected for the next time we met.</p> <p>Learning:</p> <p>I was interested in this studio particularly because of the interdisciplinary aspect, but also because I had yet to enter a competition and wanted the experience before fifth year since it would enable me to sharpen my presentation skills. 1) I feel I have made huge strides in my communication and presentation skills.</p> <p>2) I have also reinforced both design theory and developed a sense of structural understanding that I can use to better inform my projects and thus make them stronger.</p>

	<p>3) I have learned that miscommunication is possible despite valiant efforts to prevent it.</p> <p>I'm not sure that I did expect anything more from studio that I did not make some strides towards. For me, this studio allowed me to push myself in a new direction, to integrate structural aspects into the very design process and thus better inform the final design.</p> <p>For the steel competition studio I used my knowledge of hand drawing for early concept sketches, moving into Rhino and 3D Studio Max to model and render the final images for submittal. While this is the typical way I approach design, in this interdisciplinary studio I also had the opportunity to incorporate the ideas and knowledge of our ARCE team members into the project. This in turn helped to inform the design and was reflected in a much stronger overall design concept reinforced by many aspects of the project.</p> <p>Course Structure:</p> <p>I thought the field trips were enormously helpful. I attended a few ARCE sessions that my ARCE colleagues had with the ARCE Professor Kevin Dong, during the spring quarter after asking if it would be appropriate, and it allowed me the opportunity to see and hear specifically the details of what they were working on (regarding some of the calculations for the project structure, etc). This enabled me to give them relevant information in a timelier manner as well as hear Kevin's suggestions and comments directly.</p> <p>Other:</p> <p>I truly enjoyed this course and this project, especially the multidisciplinary aspect. I really feel it has strengthened my design theory and I look forward to exploring this multidisciplinary theme in future work.</p>
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Project Narrative:	urban PRE-FABric
 <p>PEDESTRIAN ACCESS</p>  <p>VEHICULAR ACCESS</p>  <p>COMMERCIAL</p>  <p>DWELLING UNITS</p>  <p>TERMINAL</p>	<p>The concept for this project is a coalescence of a dense urban population manifested into a hub of transport and dwelling. The marriage of the permanent and transient population on our site symbolizes the interweaving of this urban fabric.</p> <p>Project Location: Colman Dock - Seattle, Washington</p> <p>Concept Explanation:</p> <p>This particular site is pivotal to Seattle's population. It is where the human chaos of the city meets the tranquility of the oceanfront, a nexus for people coming and going on every manner of business. From weekday warriors to football and baseball fans, thousands of Seattleites traverse this ground every day. From a historical perspective, the site sits on the corner where Seattle as a whole made the transition from postindustrial cityscape to modern metropolis. Colman Dock lies at the exact point where the grid of the old city to the south meets and merges with the lines of the new. Our design problem, to create a mixed-use residential and commercial project on the site of the existing dock while redesigning the ferry terminal, adds two new threads to this already complex urban fabric. Our design was driven by the need to make sense of seemingly discordant elements and make them sing, all the while emphasizing modern sustainable principles and prefabricated elements. By synthesizing temporal aspects and tectonic forms with the confluent streams of traffic on the site, we hope to create an architectural aggregate of Seattle.</p> <p>Four finger-like structures, recalling the wharves of the old industrial waterfront, reach out over the water, floating on tripod piers. These piers penetrate the commercial space below, creating light wells and green space. On the roof of the commercial spaces, are the alleys, submerged between these structures to provide pedestrian circulation and access to the ferry terminals. They provide an intermediate circulation space between commercial, residential, and ferry uses. Aligned with the city streets, these arteries also provide a strong visual connection to the city. In plan their orientation shifts, sharing the lines of the old city grid as well as the new. The two alleys are connected by park space along the street front, and a pedestrian bridge on the waterside. The pedestrian bridge pivots at its center to allow residents with maritime tendencies to access the harbor at the project's center. Sail boats are a mainstay of Seattle culture, and this "third alley" would give residents the opportunity for private anchorage.</p> <p>Ecology and economy were major concerns when designing the residential units. We designed them as pre-fabricated steel pods which can be inserted into the skeletal structure of the buildings after site construction is complete. Building the units en masse of site saves considerable time and money. The checkerboard distribution of the dwellings within the structural frame not only improves passive ventilation and natural light, but allows the unique opportunity for each resident to have a private outdoor space adjoined to their housing unit. Overall, this system will save money, time, and energy while improving quality of life in an urban setting.</p>



Urban PRE-FABric

COLMAN DOCK
SEATTLE, WASHINGTON

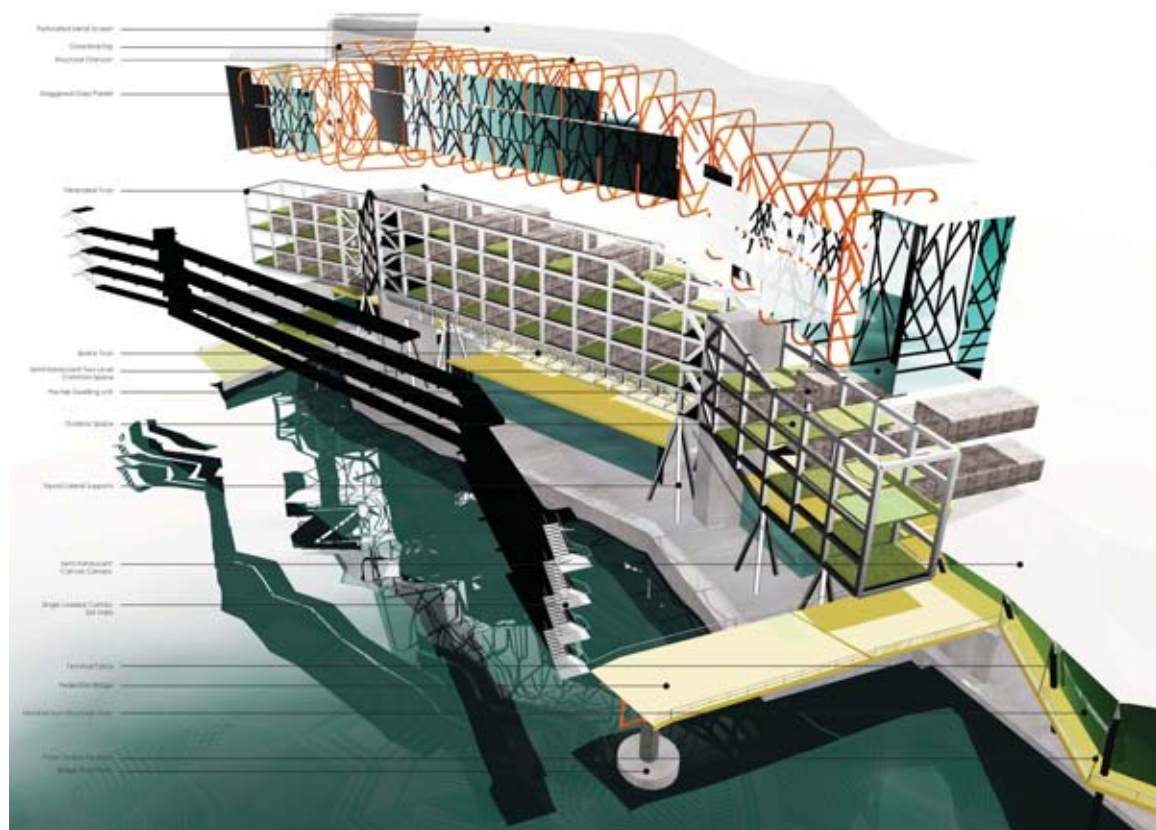
The "urban fabric" of Seattle, Washington is most prevalent at Colman Dock, where the public flows constantly, each individual pursuing their own agenda. The concept for this project is a coexistence of a dense urban population manifested into a fabric of transport and dwelling. The marriage of the permanent and transient population on our site symbolizes this interweaving of the urban fabric. The site is composed of prefabricated steel and "finger-like" tube structures with residential pre-fab units above and commercial spaces below. The pedestrian-level penetrates the water's edge as they transform into the two ferry terminals that accommodate the traveling public.

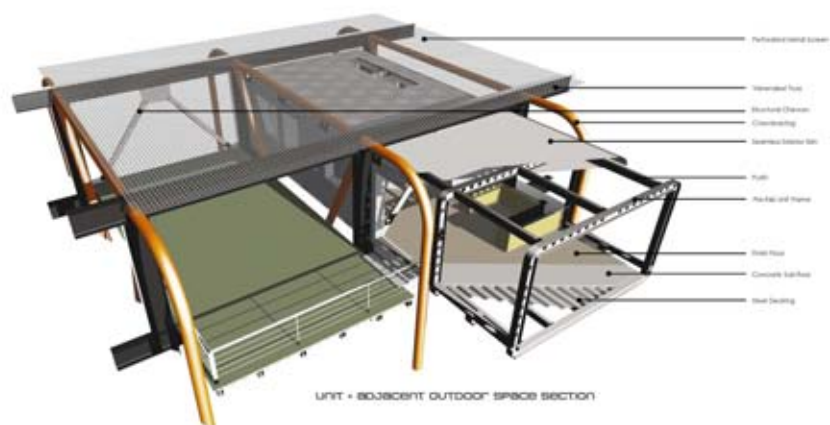
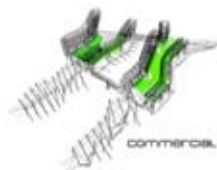
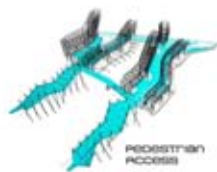






The continuous bracing between the residential bays have been allowed to give the flange of continuity, yet are welded together at each story, thus allowing the bracing to laterally support the structure in one of the principle axes. The chevron bracing is isolated of every other bays in the north and south facade of the buildings. This arrangement creates a triangulated shape throughout the frame. By triangulating the frames it stiffens and reduces deflections in the structure and transforms shear and bending forces into axial forces. The frame now behaves like a truss. The chevrons also serve to brace the columns against lateral movement. The bracing is welded to the column flanges and the column web provides support for the base of the column while also carrying the gravity forces from the structure above. In addition to the ground, a space truss located under the building provides additional stiffness to the building but is a secondary structure in necessity. The pre-cast units, once connected to the frame, act as a diaphragm to support the larger structure as it

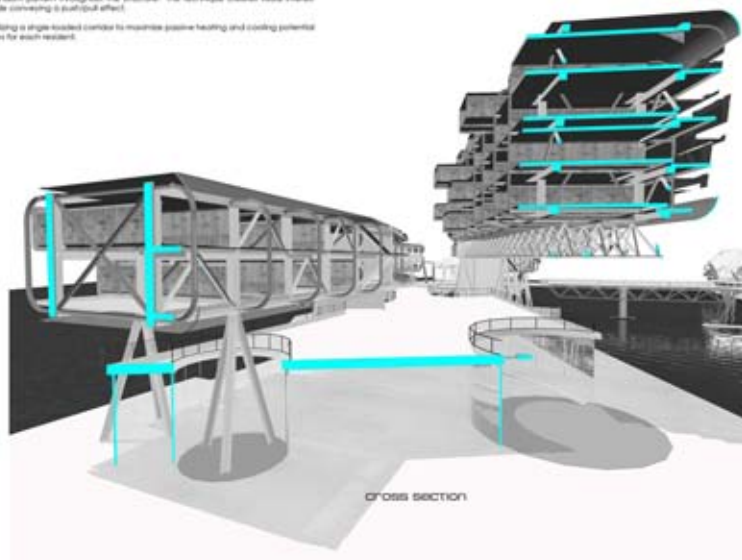




The pre-fabricated units take advantage of the streamlined tube design by their checkerboard placement. By positioning the units in a checkerboard fashion, any doubling of walls, floors or ceilings is avoided. Actually, the checkerboard placement allows for an adjoining outdoor space for each unit and adequate cross-ventilation throughout the residential units.

There are three possible layouts for these pre-fab units, each differing in length, and will be distributed in a random pattern throughout the structure. The technique creates visual interest along the north side conveying a sculptural effect.

The units are all sitting on a single raised corridor to maximize passive heating and cooling potential and maintain views for each resident.



Precedence_Case Studies



West 8, Borneo-Sporenburg

- High density/ low rise
- Create a colorful urban context
- 30-50% voids
- System of streets and alleys for vehicular and pedestrian access to site

Early Form Generation

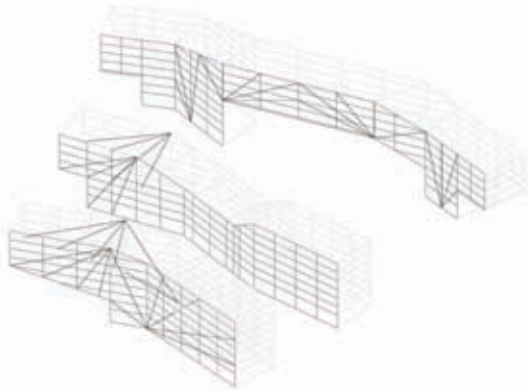


Design Development Model



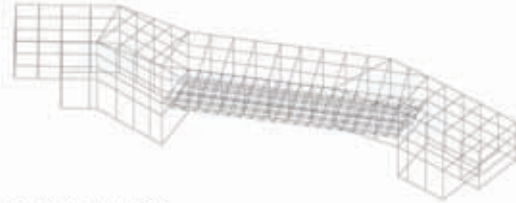
Structural Designs

Previous Design

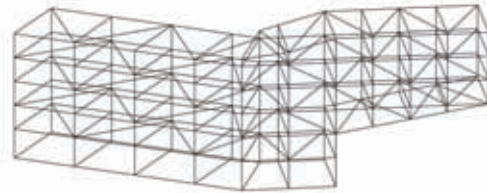


Current Structure

"Big-Span" Truss

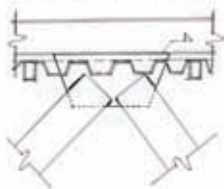


Cantilever Bracing



Detail Sketches

Pick-point connection

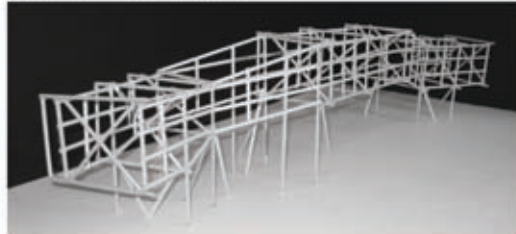


Tri-pod connection



Models

Vierendeel Truss Structure



Detail Drawings

Screens



Unit Connection

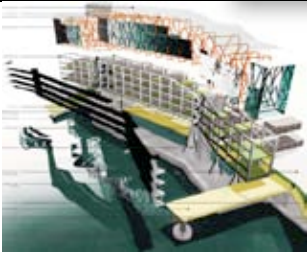


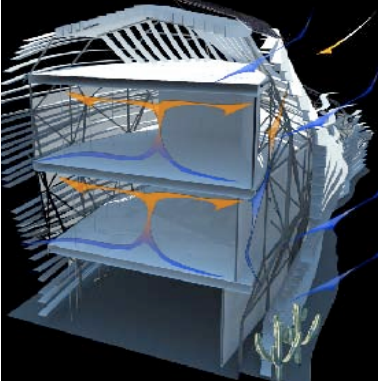
Unit Bracing



Tensile Terminal



	
	Selected Reflective Comments From Team
	<p>The winter and spring quarters spent in the interdisciplinary design studio were, without a doubt, my two most valuable quarters so far at Cal Poly. Not only were they mightily challenging for various reasons, they were educational and informative as well. I developed my digital modeling and rendering skills, worked in a design team for the first time, worked with architectural engineering students for the first time, entered an international design competition for the first time, and basically did independent study for the first time, all on one project. All in two quarters. Needless to say, it was tough, but well worth it.</p> <p>Starting in winter quarter, I had absolutely no knowledge or skills with digital modeling and rendering software. I decided to learn by doing, so I took on the role of digital designer for my group from day one. I am proud to say that by the end of spring quarter my digital skills have gone from nonexistent to top of the line. There is no better way to learn something than to just dive in and get your hands dirty.</p> <p>This project was also my introduction to working with a design team. This seemingly easy task (share the work loads, right?) turned out to be probably the most challenging aspect of the project. Instead of having complete autonomy over all design decisions, we were forced to communicate our ideas to our teammates in a clear and understandable way in order to win them over. While this seemed to slow the design process early on and cause a lot of frustration for everyone, in the end it really helped to refine and sharpen our ideas, to create a simpler, more elegant, more lucid project. I don't think that our design would have been as good if any one of us had been working alone.</p> <p>Another new variable for me to contend with during this studio was the presence of ARCE students as part of our design team. Their influence on the project was invaluable. They added an element of realism and concreteness to our project that would not have been possible without them. Though it was often a trial to convince and cajole and compromise our way to our design goals, it was a very rewarding experience. Learning to speak their trade language and attempting to find common ground in structural scheme and design was satisfying on so many levels. Again, it produced the necessity to pare down our project and crystallize our most important ideas. If a certain aspect of our design was not worth the trouble of convincing our engineers to adopt, then it didn't deserve to be in the project.</p> <p>The fact that our design project was to be entered in an international competition put an edge to the studio environment that I had never felt before. To have to perform on that stage as well as the standard critiques and reviews was extraordinary. Representing our school at that level lent us a desire to perform unlike any other; it was always in the background, urging us on.</p>

	
Project Narrative:	Aeolian Processes
	<p>We define Aeolian processes as the ability of the wind to sculpt the surface of the Earth, based on the principle theories of erosion, transportation and deposit. The East, South-East prevailing winds running across the site became a starting point for design generation. Conceptually, the building is carved out of the landscape, creating pockets of space for social interaction, exterior learning, and assembly. These spaces are located on every level of the complex including the roof spaces, which is where the skin separates enough to allow roof top access while providing shading.</p> <p>Within the next twenty years, the demographics for Phoenix Arizona predict the population to double, indicating a move toward a dense urban fabric and an increasing need for a strong cultural city core and revived green spaces. Deck Park was completed in 1990 and remains an engineering feat, consisting of cast-in-place multi-cell box girders under which ten lanes of traffic speed. The park is located within walking distance of the electric light rail system and also exists in the shadow of Burton Barr central library by Architects Will Bruder with Wendell Burnette. Designed to be a thriving recreational heart to the city, the park has, in the past 19 years since its completion, been forgotten. The placement of our proposed school of the arts will draw attention to this neglected green space near the cultural center of the city. This school, will not only become an icon visible from interstate 10, it will also encourage the redevelopment vacant lots and abandoned buildings.</p> <p>This school of the performing arts provides students with the opportunity to experience a variety of art forms and come to appreciate multiple cultures. Music, dance, and drama, and art become methods by which students are encouraged to expand their creative consciousness. The Performing Arts Center, containing the main performance hall, a black box theater and dance recital facilities, as well as secondary spaces for set construction and musical instruction, becomes a place where students of a variety of talents learn together.</p> <p>Our proposal includes a variety of classroom spaces that are designed for flexibility. The incorporation of technology into the classrooms and the placement of media labs interspersed throughout the class blocks promote learning on a global scale. The proposed school will not only perform sustainably, it will become a tool of sustainable instruction. Roof top gardens and cool roof systems reduce heat loads minimizing the use of HVAC systems. Building run off is channeled by the louvered skin and treated in a grey water system that then distributes the water to irrigate the landscape. Given the minimal annual rainfall, we propose limiting plant selections to those with attributes promoting the efficient use of water. Energy consumption is supplemented with solar collection systems.</p>

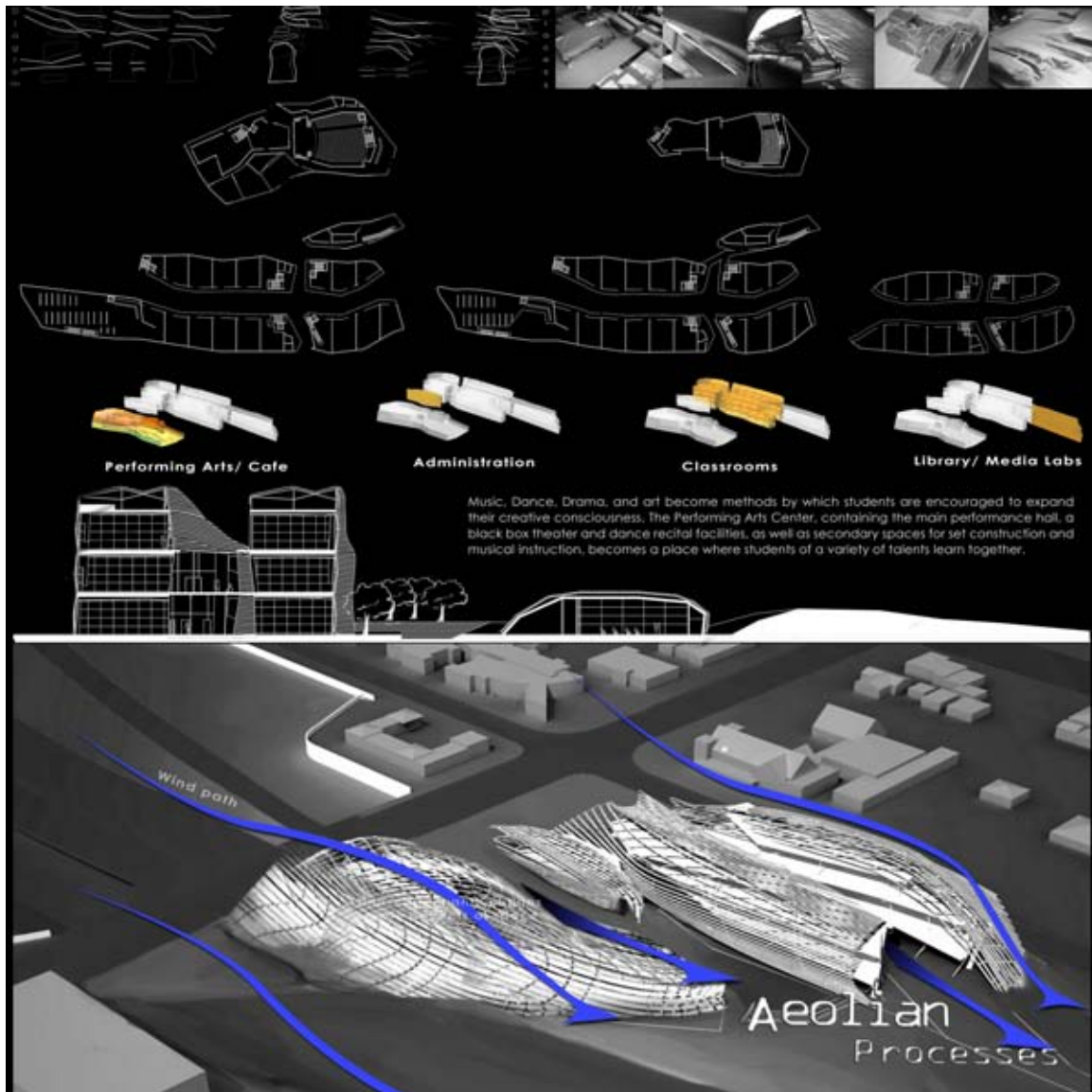


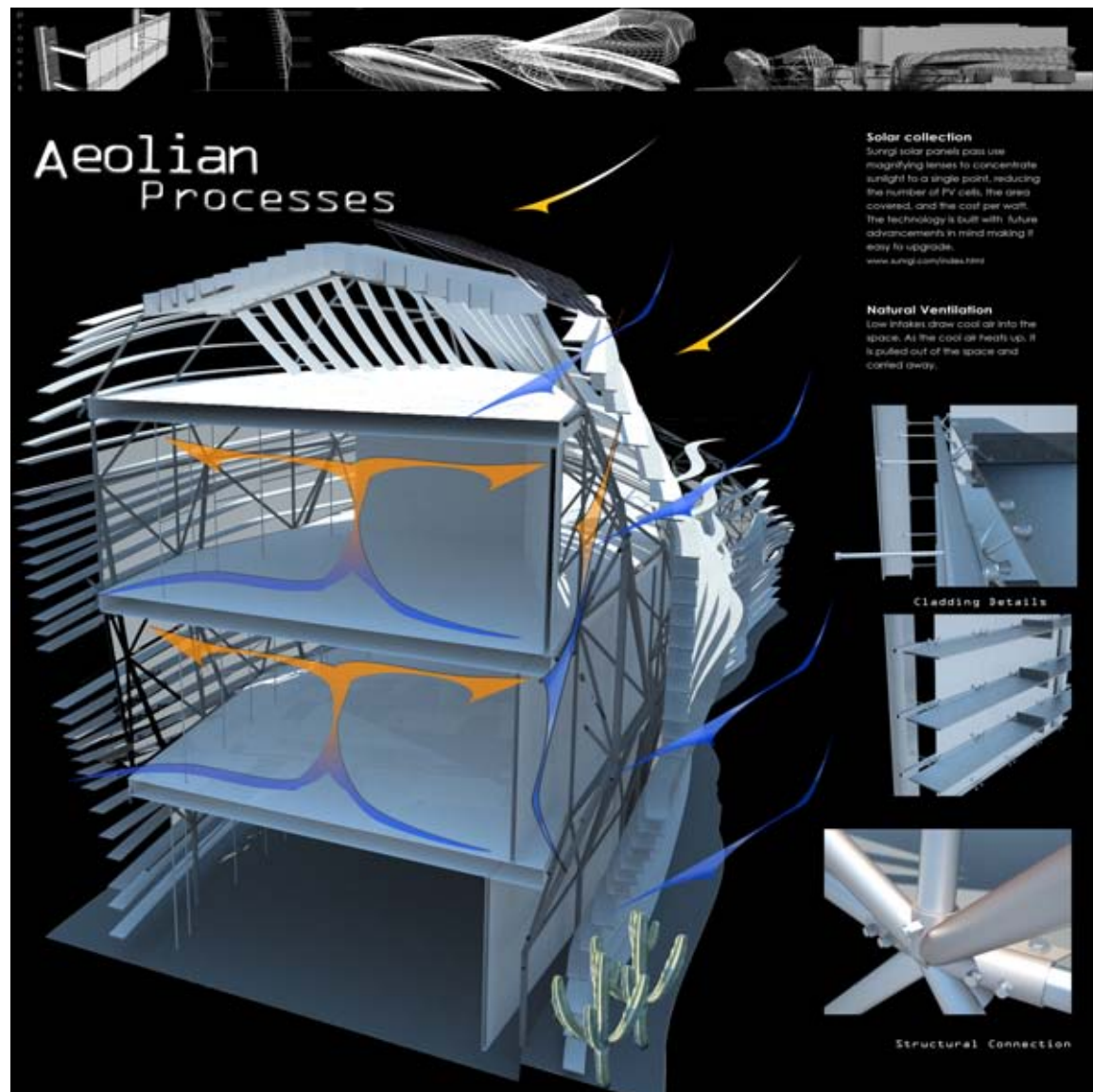
Aeolian Processes

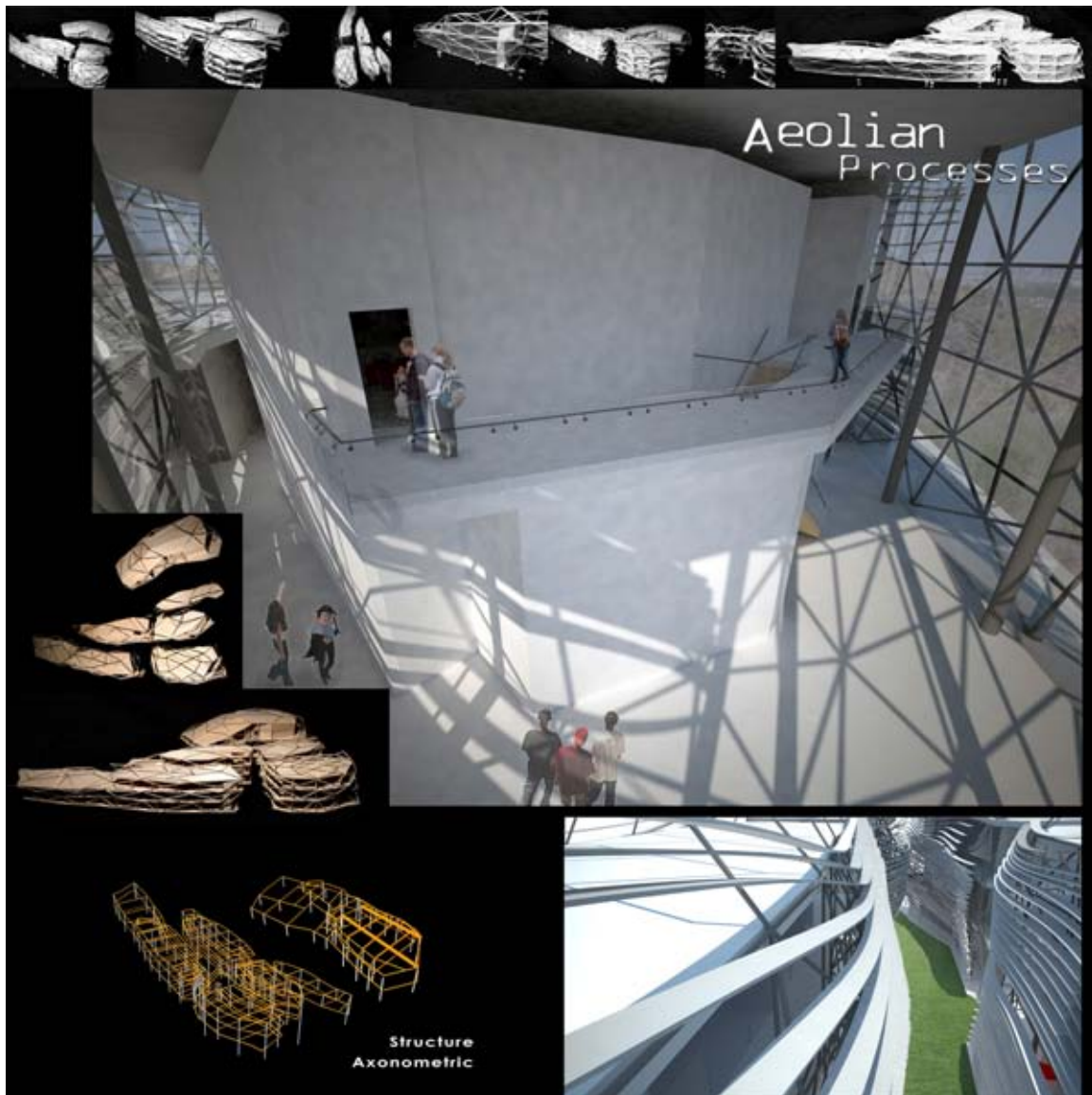
Location: Phoenix Arizona

Within the next twenty years, the demographics for Phoenix Arizona predict the population to double, indicating a move toward a dense urban fabric and an increasing need for a strong cultural city core and revived green spaces. Deck Park was completed in 1990 and remains an engineering feat, consisting of cast-in-place multicell box girders. The park is located within walking distance of the electric light rail system and also exists in the shadow of Burton Barr central library by Architects Will Bruder with Wendell Burnette. Designed to be a thriving recreational heart to the city, the park has, in the past 19 years since its completion, been forgotten. The placement of our proposed school of the arts will draw attention to this neglected green space near the cultural center of the city. This school will not only become an icon visible from Interstate 10, it will also encourage the redevelopment vacant lots and abandoned buildings.

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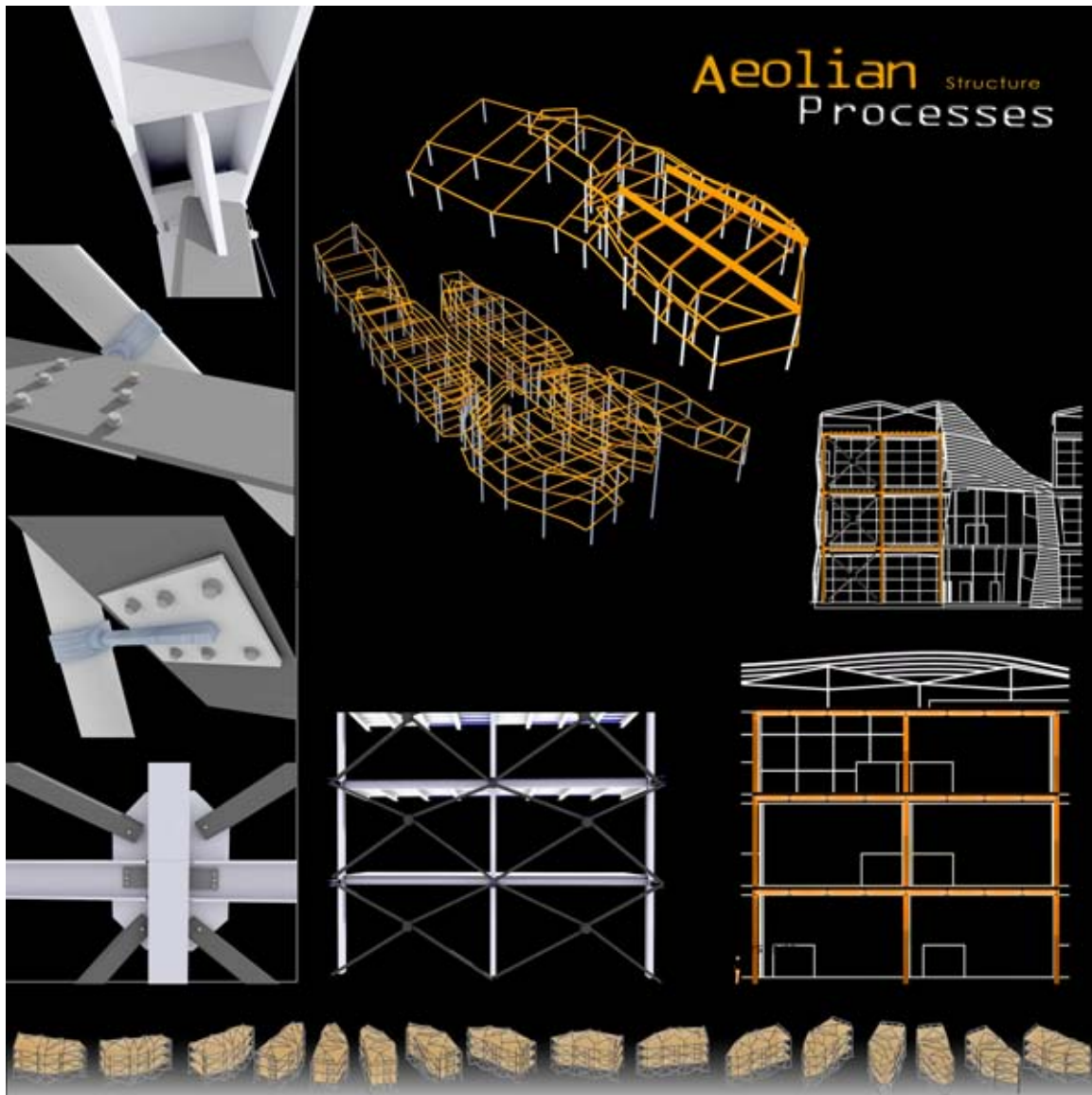






Process





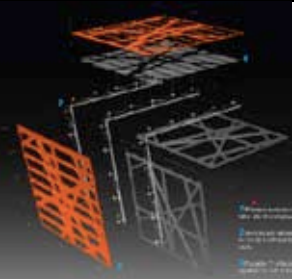


Selected Student Reflections

The ... thing I learned was that sustainable buildings in Arizona are difficult to design. With such a harsh climate it took much more thought to make each environmental design effective. Traveling there helped in this education as well. The final thing I learned was an appreciation for input outside of architecture. When we would have engineering critics I would try to fully implement their opinions into the design. Architecture can get a bit stuffy and repetitive and any beneficial input from others outside of architecture is greatly appreciated.

First off, the ARCE students were awesome. From what I hear and saw they were the most productive ARCEs and I loved what they had to say. If this is the experience of working with ARCEs from here on out I will be ecstatic. We had a great relationship of being able to discuss what would and wouldn't work in terms of architectural and structural design openly and bluntly. And they were happy to work with us to achieve the design vocabulary that we wanted. The thing that I wouldn't have been able to learn without them is that 'crazy forms' can be achieved just by tweaking the way one thinks. I was thinking about how we could cant the columns, when in reality, all that was needed was to shift the plates and have a regular structure. This made it easy on both parties. It also forced me to see how ARCEs see things and to take that into consideration when describing our design ideas. I had to be more concrete which is definitely not a bad thing.

Bringing in professionals was by far the most important experience that took place in this studio. Not only were they forward thinking in terms of design ideas, but they knew what it took to get things built. This information helped us to realize our designs in a more realistic light. If possible I would keep bringing in as many professionals as possible because it was something I had never experienced before, and something that enriched the class more than anything I had ever seen.

	
Project Narrative	Performance Driven
	<p>Performance: Performance can be a presentation of an artistic work to an audience or the effectiveness in which something functions, operates, or behaves. Why can't it be both? This High School for the Performing Arts is not only meant for performances, but also is a performance in it of itself. The building is meant to house the transition of performing students that attend the school to learn, rehearse, and ultimately perform. This idea became the basis for the programmatic organization of the school. The transition the students go through in school becomes the circulation path on the site that flows from private to public as the students learn, rehearse, and perform for the community.</p> <p>Site: The site is Deck Park, just north of downtown Phoenix, Arizona and next to the Phoenix Central Library located in the art district of the city. The site is situated above Freeway 10 and can be seen when driving on the freeway. Considering that Phoenix has extreme climatic conditions, it is preferable that the building would be passively cooled and heated to reduce the use of mechanical systems and thus, reduce the impact on the environment. The site is currently not in much use. With the introduction of a High School for the Performing Arts on this site, we will bring a sense of community back to the city. By developing this area that otherwise would be neglected, we can avoid the development of green lands and help preserve the natural environment.</p> <p>Organization: After studying the art and tapestry of the Navajo, a Native American group of the area, we observed the qualities of the positive and negative spaces created by their forms. With this, we allowed the programmatic spaces to be strategically arranged so that the negative spaces created become a part of the program. The result is a series of courtyards that are the focus and heart of the school and also help connect the Performing Arts Center, the school, and the park. The program of the building consists of learning, rehearsing, and performing spaces with support spaces for each of them. By creating a gradient from learning to performing, spaces are organized in a sense that allows the horizontal and vertical circulation to guide the occupants to where they need to be.</p> <p>Skin + Structure: The primary structure, although at first glance, appears as a chaotic web of steel members, consists of a series of standardized panels of steel tubes. Each panel is made up of a hidden cross member and infill elements that are added for additional support as well as complexity. The structure's redundancy allows the members to be smaller and it helps minimize the need for lateral support. The structure panels inform the skin and create certain openings in their intersection and overlapping in order to control sunlight. The skin itself consists of a series of louvers, or fins, that are oriented either vertically or horizontally depending on the orientation. The skin is attached to the primary structure through a series of smaller members that are placed across the primary structure. The building's south and north walls tilt down towards the south at 10 degrees in order to prevent direct summer and solstice sunlight from the south and to maximize the amount of indirect north light that come into the classrooms and lab spaces.</p>

Performance Driven *Phoenix High School for the performing arts*



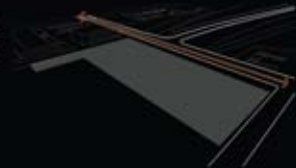
Phoenix Arizona, population 1,552,259



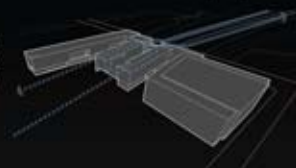
USA, population 306,346,872

Urban growth and decay in our communities has become a major challenge that we should begin to approach with a total life cycle assessment of our buildings. This proposed high school for the performing arts seeks an approach that is performance driven in nature; capable of housing its current programmatic needs as well as any future redevelopments. As a performance driven institution, the organization of the school seeks to emphasize the transition and transformation of students from a learning experience, to rehearsal and ultimately reaching the performance stages. The building also addresses environmental issues that are driven by site-specific needs in its location of Phoenix, Arizona.

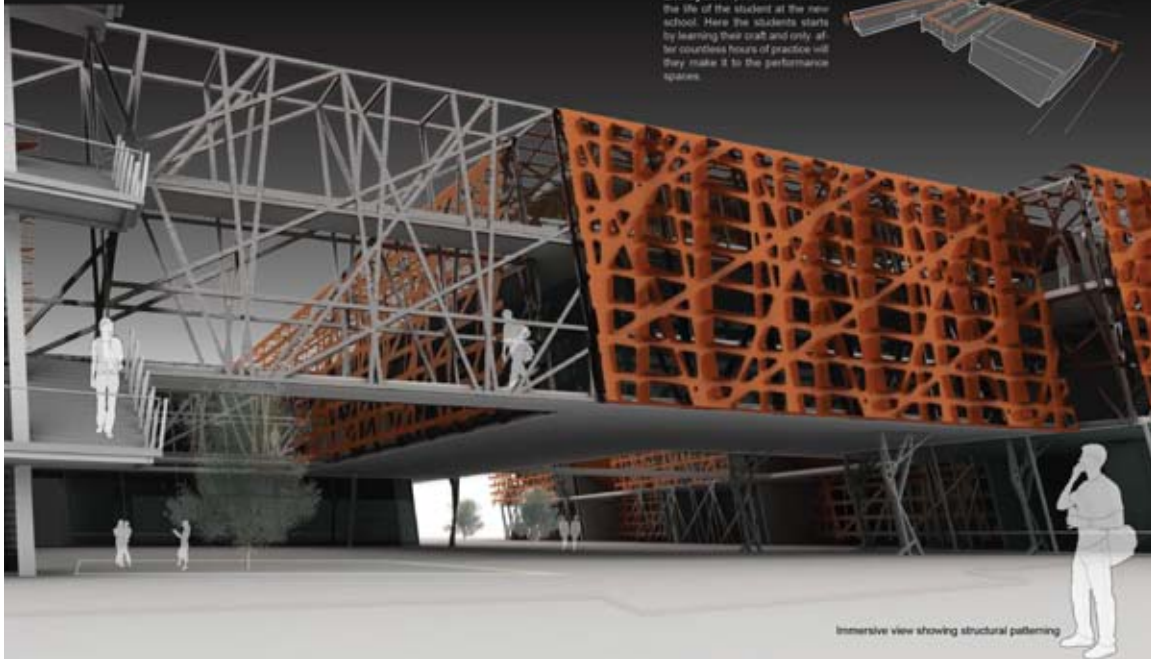
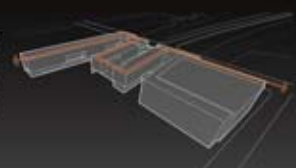
Stage. The main boulevard poses as a stage for improvisational performances and practice sessions. How do you begin to respond to this type of condition?



Force. The freeway acts as an environmental force, wanting to push it's way through the site. This force begins to inform the shape of the path.

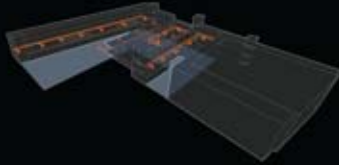


Life Cycle. A path is now set for the life of the student at the new school. Here the students starts by learning their craft and only after countless hours of practice will they make it to the performance spaces.

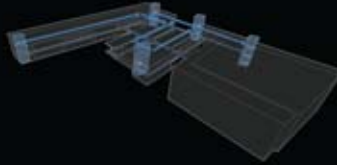


Immersive view showing structural patterning

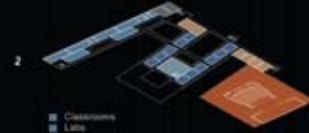
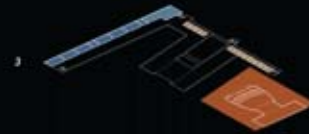
Programmatic Performance Phoenix High School for the performing arts



The organization of the program creates a series of **courtyards**. These courtyards translate into outdoor performing spaces which activate the upper levels by engaging the occupants to respond to the performances below.



The horizontal **circulation** lies on the perimeter of the program spaces guiding the students from learning spaces to rehearsing and finally to performing spaces. The vertical circulation is located at the ends of program spaces and allows for the transition from level to level.



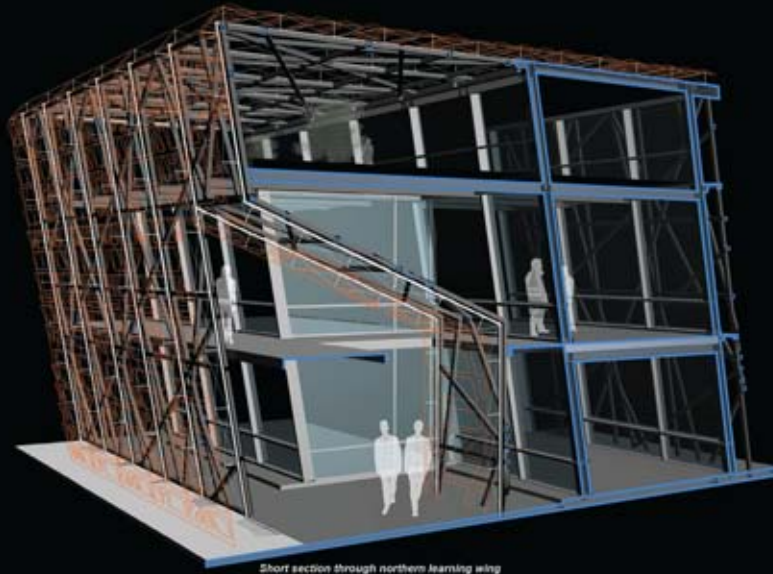
- Classrooms
- Lobby
- Library
- Administration
- Cafeteria
- Rehearsal
- Concert studio
- Auditorium



A study of local Native American tribe art and tapestries began to inform the organization of spaces. The rectilinear qualities as well as the **positive and negative spaces** created in Navajo art and tapestry, were translated into the spaces for the school. The negative spaces became part of the program—in the form of courtyards.



Structured Performance Phoenix High School for the performing arts



Short section through northern learning wing

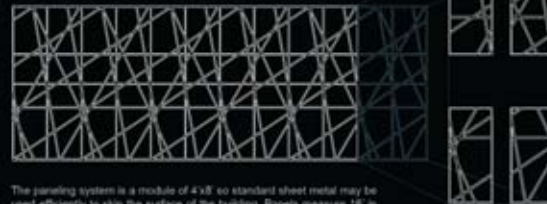


Immersive view within northern learning wing



Immersive view within northern learning wing

The primary structure, at first glance, appears to be a chaotic web of tube steel. In actuality, the web consists of a standardized pattern made up of a system of only 4 unique panels. The panels are pre-manufactured in-house and trucked to the site where they are joined together on-site with a series of bolted slip joints. The redundancy of the structure allows for the system to take lateral and gravitational loads. Situating the structure on the exterior of the building allows for spaces to be free and re-arrangeable for future developments.



The paneling system is a module of 4x8' to standard sheet metal may be used efficiently to skin the surface of the building. Panels measure 16' in length allowing for easy trucking to the site through the Phoenix area.

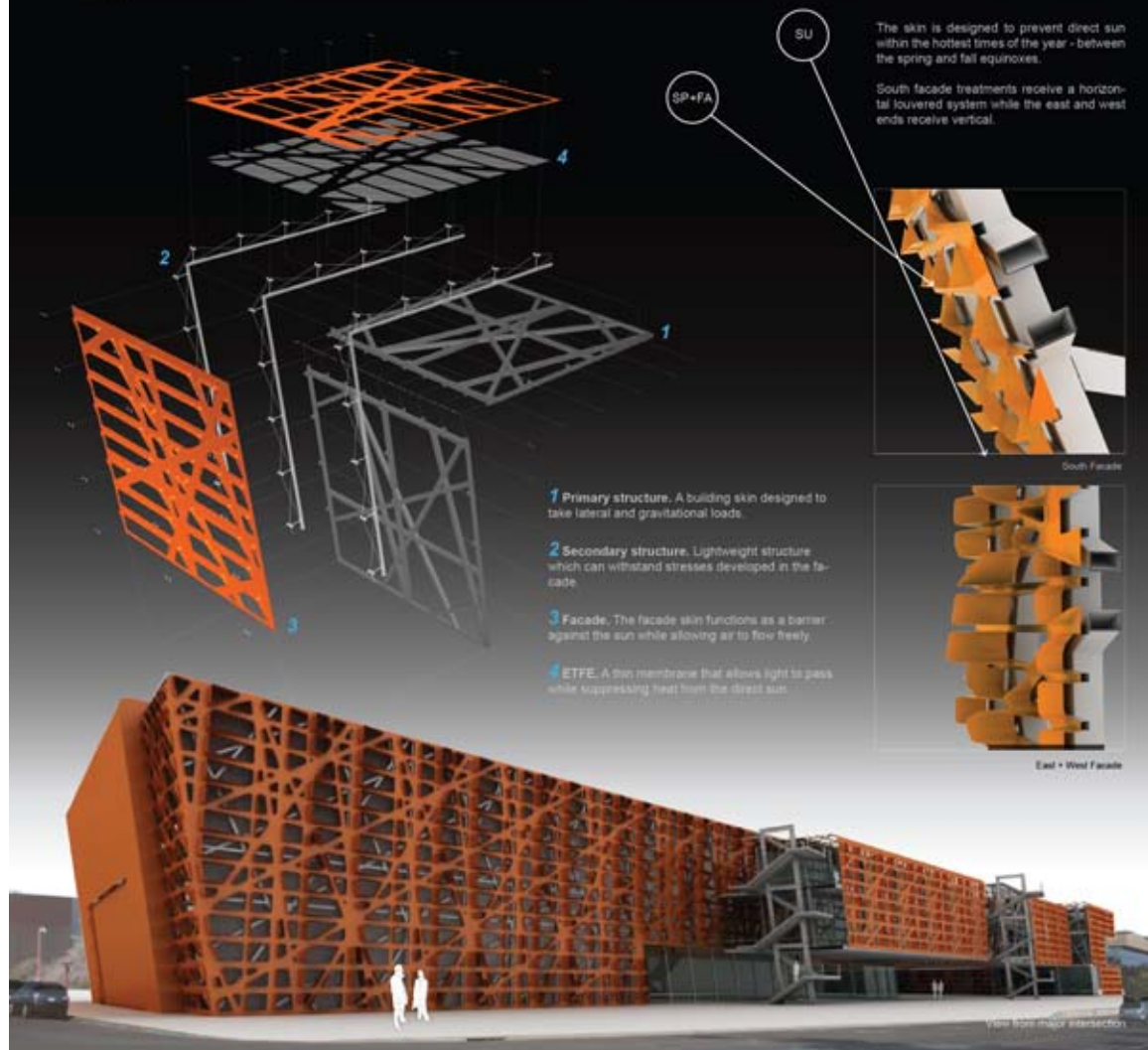
■ Skin
□ Conditioned space



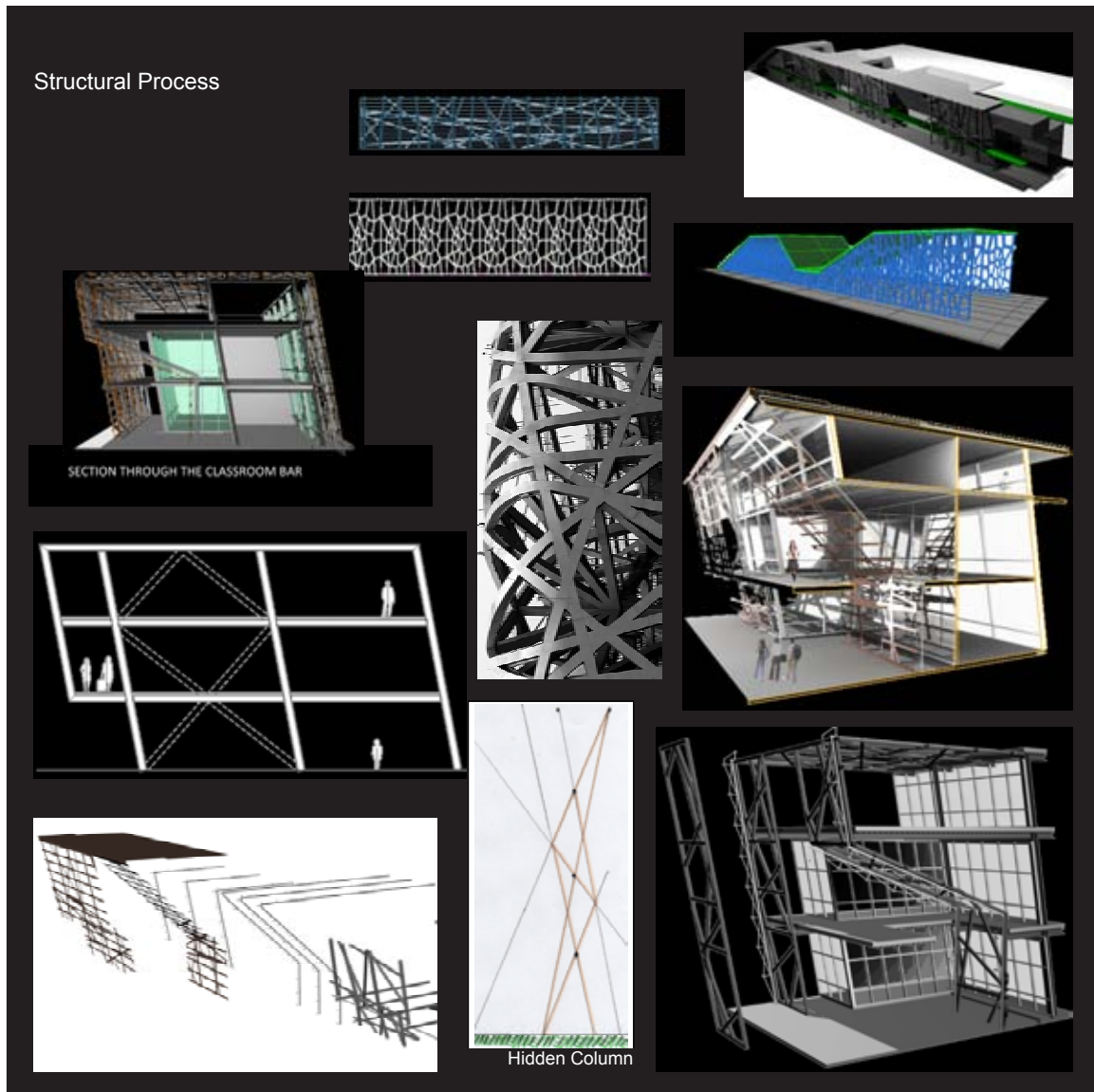
Long section showing skin+space relationship

Façade Performance

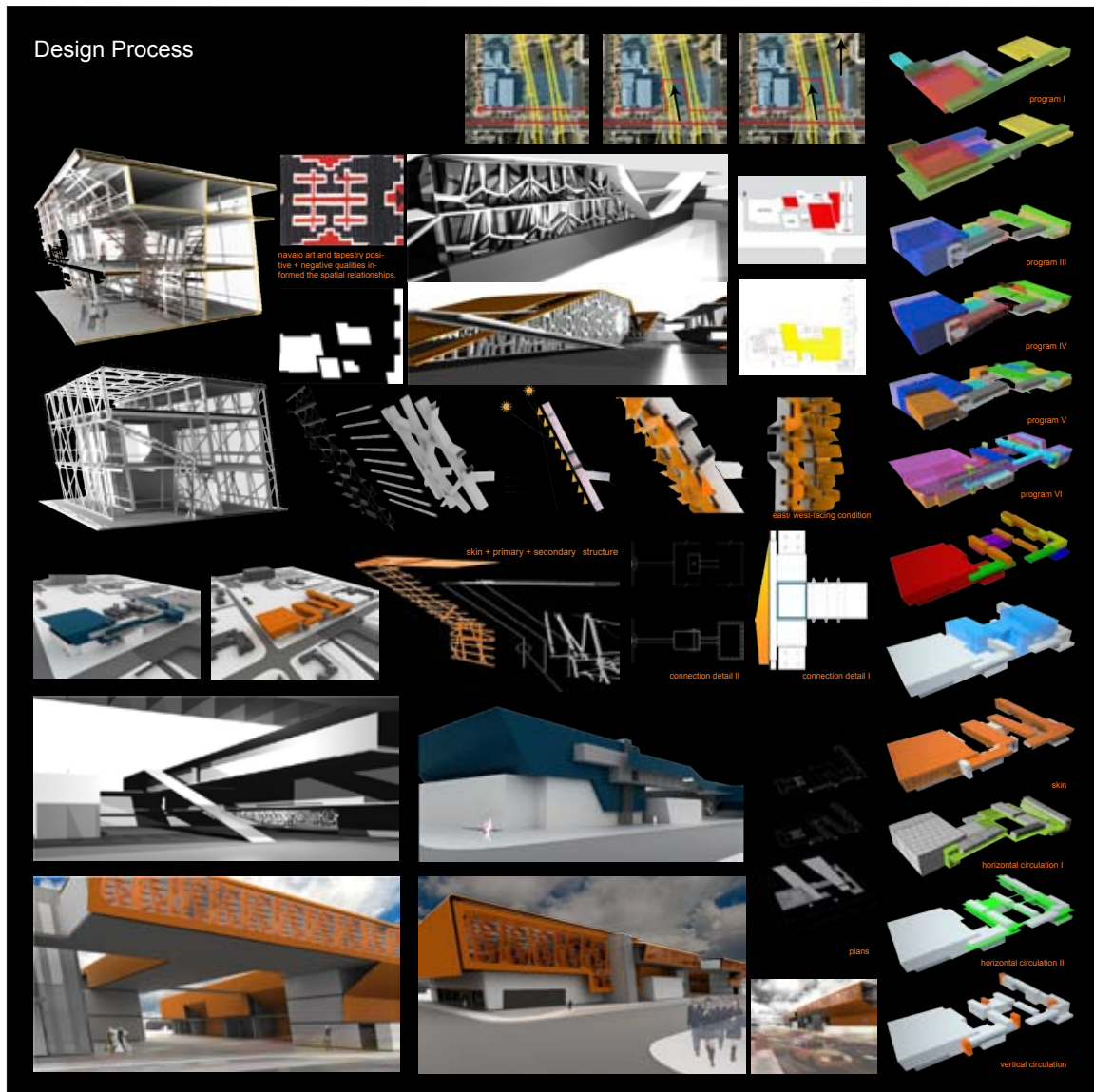
Phoenix High School for the performing arts

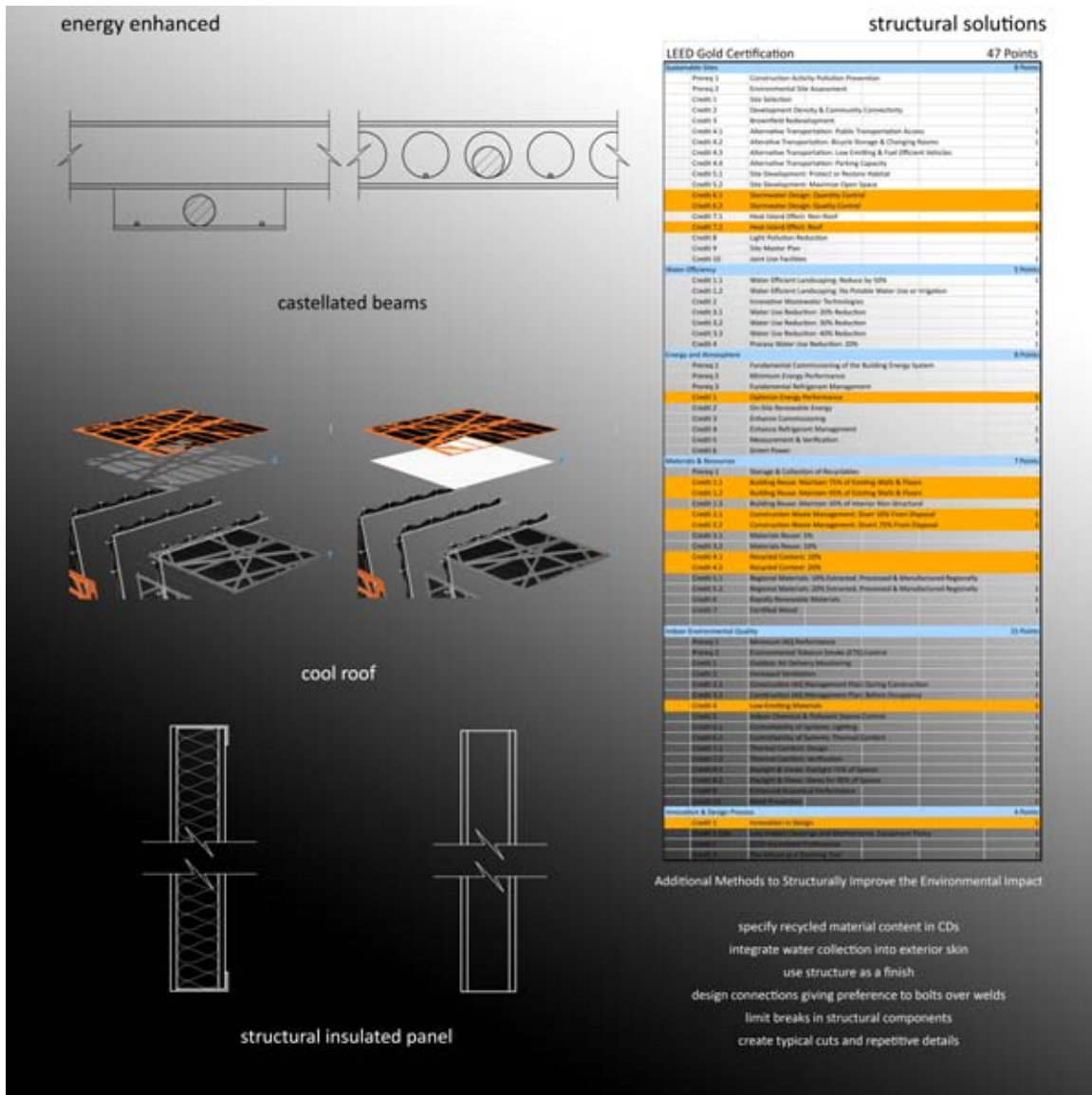


Structural Process

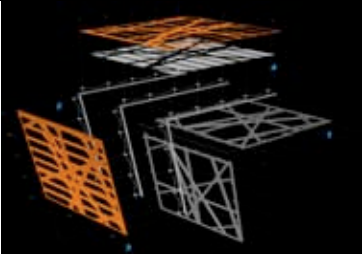


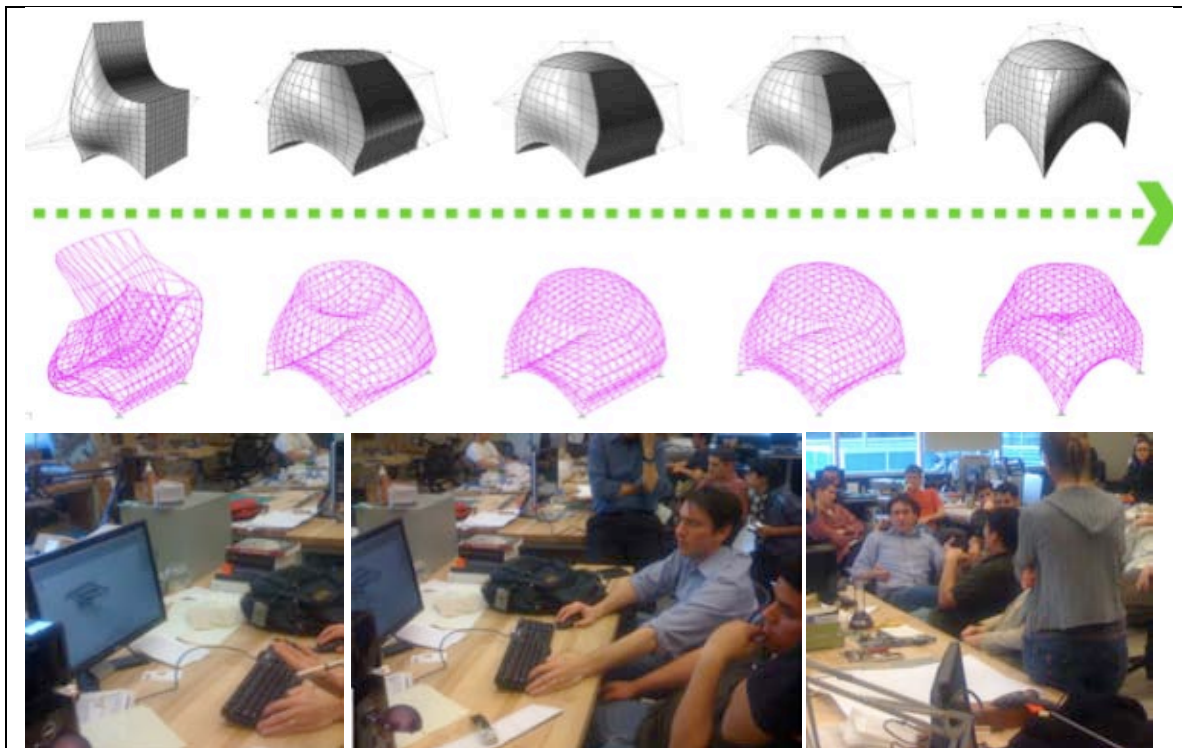
Design Process





CM Student's LEED Gold Certification Analysis for the project

	
	Selected Student Reflections
	<p>The top three things that I learned in this studio experience include working efficiently with a group, the application of structural concepts in the design process, and the benefits of using (advanced digital) technology for the development and presentation of a project. Some of the things that contributed to this learning experience include the involvement of professors, the field trips to the site and related projects and the involvement of professionals in our design process.</p> <p>By working in this interdisciplinary group I feel that we all greatly learned from each other. We were able to put aside our differences and work together as a team to achieve our project goals. Working with the Architectural Engineers helped us develop our structure so that both the architects and the engineers were content with the outcomes. I think this experience is unique here at Cal Poly and I feel other majors should also collaborate with different disciplines. This is something that will benefit us in the future when we get into the workforce and have to work with many different fields of study.</p> <p>Participating Professionals</p> <p>The participation of the different range of professionals greatly assisted our group to further develop our project. In person reviews were probably the best due to the ease of communication of our concepts and ideas. Through their critiques and suggestions we were able to make changes and take into consideration issues that we would of never have thought of. I feel that the web conferencing was beneficial...Web conferencing is a great tool...</p> <p>Visiting the actual firms was probably one of the best experiences that I enjoyed about this class.</p>



Selected Workshop (Form-Finding)

Architecture and Architectural Engineering students worked in teams with a practicing structural engineer and developed 3D RISA (structural analysis software) and Rhino (Digital Modeling Software) to push the boundaries for exploring the structural possibilities for the project.



Selected Design Charrette (Structural Load Testing)

This is typical warm up assignment for interdisciplinary teams.



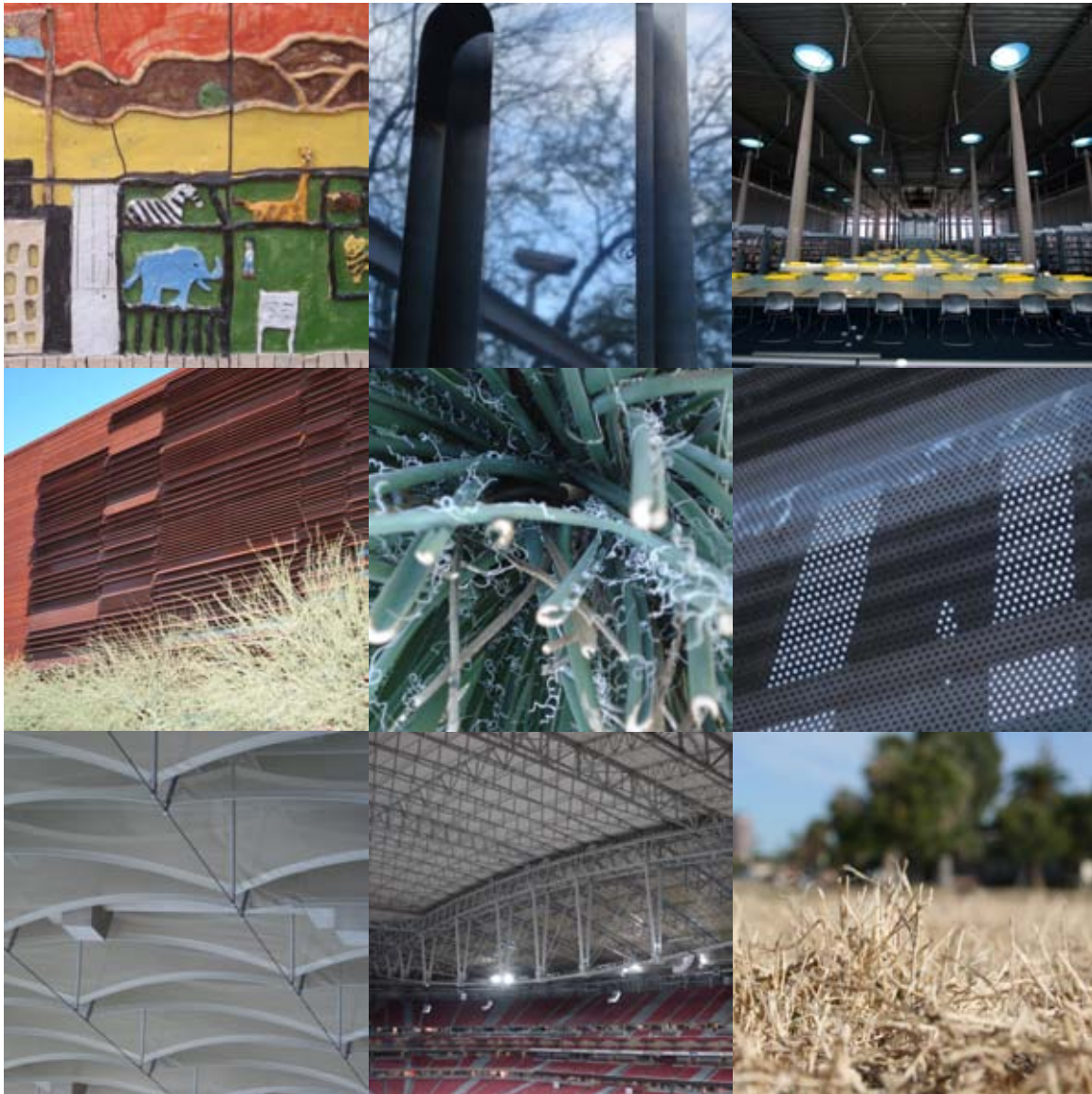
MVRD – Silodam

Neighborhood Analysis

Building Structure

Selected Precedent Study (Housing Analysis)

Architecture and Architectural Engineering students worked in teams to analyze a selected building both architecturally and structurally. The case study buildings provided to each of the teams are similar in program and scale to the project being designed in the *Collaboratory*. Where possible, case study projects are selected that can be visited during the out of state field trips and/or have been designed by the practitioner firms that are involved with the *Collaboratory*.



Field Trip to Phoenix, AZ